THE PLANT DISEASE REPORTER

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Volume 38 Number 2

February 15, 1954

The Plant Disease Reporter is issued as a service to plant pathologists throughout the United States. It contains reports, summaries, observations, and comments submitted voluntarily by qualified observers. These reports often are in the form of suggestions, queries, and opinions, frequently purely tentative, offered for consideration or discussion rather than as matters of established fact. In accepting and publishing this material the Section of Mycology and Disease Survey serves merely as an informational clearing house. It does not assume responsibility for the subject matter.

THE PLANT DISEASE REPORTER

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THE PLANT DISEASE SURVEY
SECTION OF MYCOLOGY AND DISEASE SURVEY

Horticultural Crops Branch — Plant Industry Station, Beltsville, Maryland
Volume 38 — February 15, 1954 — Number 2

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PRELIMINARY TRIALS OF D-D HI-SIL AS A SOIL FUMIGANT

A. L. Taylor and A. Morgan Golden[1]

The present methods of applying soil fumigants for control of nematodes, while fully practical, are far from ideal. Even the best of the applicators which have been devised for this purpose often do not function properly, due to corrosion or deterioration of parts, presence of soil particles or other foreign matter in the liquid, leakage at pipe and tubing connections, or improper calibration. In addition, no satisfactory methods of applying these materials on a small scale with improvised equipment have been devised. A large part of these troubles is due to the liquid nature of the fumigants themselves, so it has often been suggested that solid material which can be applied as a powder be substituted for the liquid. However, the solid materials that have been found to be useful for nematode control have been considerably less efficient than the present liquid fumigants.

The D-D Hi-Sil used in these experiments is a new approach to the application problem. It was received through the courtesy of Mr. W. E. Bissinger, Assistant Director of Research, Columbia-Southern Chemical Company, Barberton, Ohio. It was a mixture of 64 percent (by weight) of D-D[2] and Hi-Sil[3]. It was a dark brown powder, apparently dry and with no tendency to cake. When exposed to the air, it became lighter in color, probably due to evaporation of the D-D; but a ten-pound sample kept for five months in a sealed jar showed no appreciable change before being used in the experiments.

Procedure

Two experiments, one in the greenhouse and the other in the field, were conducted during the summer of 1953 at Beltsville, Maryland.

For the greenhouse experiment a bench filled with about six inches of sandy soil heavily infested with root-knot nematodes (Meloidogyne incognita var. acrita Chitwood, 1949) was used. At the time of treatment, the soil had been prepared as for planting, the soil moisture was optimum for good germination of seed, and the soil temperature was about 20° C. Two replications of each treatment were made in plots a little less than 4 feet square. The D-D Hi-Sil was applied by first punching holes in the soil about an inch in diameter and 3 inches deep, at intervals of 12 inches, in staggered rows 12 inches apart. A measured quantity of the material was placed in each hole, a tin funnel being used to make sure that the material fell to the bottom of the hole. Ordinary kitchen measuring spoons were used to measure and place the D-D Hi-Sil, previous calibration having shown that the slightly rounded quarter-teaspoon held 1 gram, the half-teaspoon 2 grams, and the teaspoon 4 grams, the error being less than 0.1 gram in each case. Each hole was filled with soil immediately after the material was applied and the plots were raked lightly after treatment was completed to smooth the surface. No cover or water seal was used. Amounts applied were: none, 1 gram, 2 grams, 4 grams, or 8 grams per square foot.

The greenhouse plots were treated on June 5 and on that same day, one row of squash seed was planted along one edge of each plot. Five additional rows of squash seed were planted at intervals of two or three days, the last row being planted 12 days after treatment.

For the field experiment sand and gravel soil was used. This had been prepared as for planting, the soil moisture was again optimum for germination of seed, and the soil temperature was about 20° C. at the time of treating. Individual plots were 6 feet square and were arranged in randomized blocks. Amounts of D-D Hi-Sil applied per square foot were the same as used in the greenhouse experiment. It was intended to have four replications of each treatment, but lack of material prevented treating one plot in the series receiving 4 grams per square foot. Treatment procedure was similar to that used in the greenhouse experiment except that the holes were punched 6 inches deep.

One row of string bean seed was planted in each plot on the day the plots were treated and

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[1] Nematologist and Assistant Nematologist, respectively, U. S. Department of Agriculture, Agricultural Research Service, Beltsville, Maryland.

[2] D-D is a mixture of dichloropropene and dichloropropane manufactured by the Shell Chemical Corporation and extensively used as a soil fumigant.

[3] Hi-Sil is the trade name for a finely powdered silicon compound produced by Columbia-Southern Chemical Co.

five additional rows were planted at intervals of two or three days thereafter, the last planting being 15 days after treatment.

Results

In the greenhouse experiment, the effect of the D-D Hi-Sil on the root-knot nematodes was estimated by removing the roots of the squash plants from the soil about six weeks after treating and examining them for root knot. Each root was rated on the following scale: 1 = no root knot; 2 = trace of root knot; 3 = light infection; 4 = moderate infection; and 5 = heavy infection. The effect of the treatments on the growth of the squash plants was estimated by weighing the tops of the plants from each plot. Average weight per plant is given in the Table. In this experiment, there was no marked effect on plant growth which could be correlated with date of planting, but germination in the plots receiving 8 grams per square foot was reduced about one-third.

Table 1. Average green weight of tops and average root-knot index of squash plants from greenhouse experiment, with average numbers of living soil nematodes in soil samples from field plots, following D-D Hi-Sil soil treatment.

Amount of D-D Hi-Sil, grams per sq. ft.	Squash from greenhouse		Soil from field plots	
	Green weight (grams)	Root-knot index[a]	Number of nematodes	Percent reduction from control
0 (Control)	47.2	4.6	109	--
1	104.9	3.3	43	61
2	131.7	2.4	21	81
4	190.6	1.4	11	90
8	148.7	1.1	2	98

[a] See text.

Discussion and Conclusions

Control of nematodes as shown by average root-knot index of squash plants and average reduction of numbers of living nematodes in the soil, was satisfactory with 4 grams of D-D Hi-Sil per square foot. This rate of application is equivalent to about 24.7 gallons of D-D per acre. The usual recommendation for application of D-D is 20 to 30 gallons per acre. Thus, the results obtained were about what would be expected from applications of equivalent amounts of D-D per acre.

Also, the effects of the treatments on the growth of plants were about what would be expected after equivalent applications of D-D and planting at similar intervals after treatment. Distinct symptoms of toxicity to plants can be expected if excessive amounts of D-D are used, as in the case of the plots receiving 8 grams of D-D Hi-Sil per square foot, or if seed is planted prior to two weeks after treatment where optimum amounts of D-D are used, as was most of the seed in these experiments.

In the data obtained, there was no indication that mixing D-D with Hi-Sil had any effect on its efficacy as a soil fumigant. So far as can be judged from the data, nematode control and toxicity to plants was neither increased nor decreased.

On the other hand, there may be a distinct advantage in application of the material. The method used would be nearly ideal for the home gardener or other small user, since only improvised equipment need be used. The only improvement suggested is that the material be made available in pellet form to eliminate measuring. Also, since D-D Hi-Sil does not have to be mixed with the soil, but can simply be placed at the proper depth and immediately covered, it could be applied on a large scale by some types of fertilizer distributors. Whether or not application of a powder to the soil would be more satisfactory than application of a liquid remains to be seen, but it is certain that it would eliminate many of the troubles which plague the operator of an applicator for liquid soil fumigants.

U. S. DEPARTMENT OF AGRICULTURE, AGRICULTURAL RESEARCH SERVICE, BELTSVILLE, MARYLAND

THE USE OF VERMICULITE AS A CARRIER FOR VOLATILE, LIQUID FUMIGANTS TO CONTROL NEMATODES

J. N. Sasser and C. J. Nusbaum[1]

The use of vermiculite[2] as a carrier for volatile, liquid fumigants is not new. Hammer[3, 4] in 1943 used vermiculite as a carrier for ethylene chloride, propylene chloride, and other materials to control the peach tree borer, Synanthedon sp. With a view to simplifying the method of application of such commonly used soil fumigants as D-D (dichloropropene mixtures) and EDB (ethylene dibromide) for nematode control, experiments were conducted to determine the suitability of vermiculite as a carrier for these materials.

EXPERIMENTAL PROCEDURES

Greenhouse Tests

Ethylene dibromide (Dowfume W-85) was added to No. 4 grade vermiculite at the rate of 225 ml. per cubic foot. This mixture was used to treat root-knot nematode infested soil in the greenhouse. Eight-inch clay pots were used. Rates of application were 2, 4, and 6 level tablespoons of the treated vermiculite per pot, corresponding to 0.7, 1.5, and 3.0 ml. of Dowfume W-85 per cubic foot of soil, respectively. The material was placed approximately in the center of the soil mass; the soil surface was then given a water seal. All treatments, including non-treated controls, were replicated five times. At the end of two weeks, one nematode-free tomato seedling (Rutgers variety) was transplanted to each of the treated and non-treated pots as an indicator plant for root knot. The plants were allowed to grow for 30 days and then were examined for root-knot nematode galls.

Results: Non-treated checks averaged 182 galls per plant, whereas complete control of root knot was obtained in the other treatments. Figure 1 shows tomato seedlings (A) grown in soil treated at the rate of 4 tablespoons of the ethylene dibromide-vermiculite mixture per pot in comparison with plants (B) grown in non-treated soil.

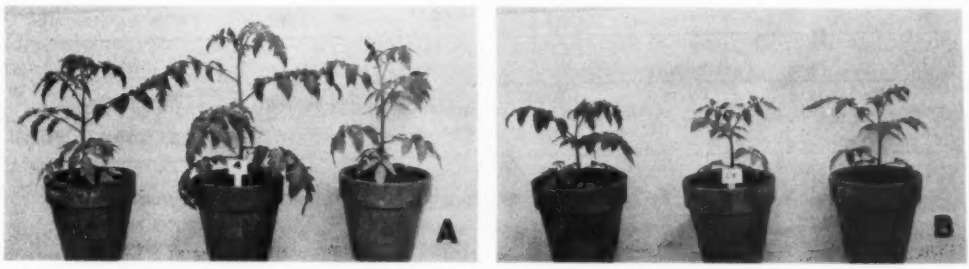

FIGURE 1. Tomato plants growing in (A) soil treated with EDB-vermiculite mixture and (B) non-treated soil.

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[1] Grateful acknowledgment is made to Mr. L. N. James, Bethel, North Carolina, for making land and facilities available, for tending the crop, and for his kind cooperation in conducting the field tests.

[2] Vermiculite is a lightweight, micaceous mineral. A hydrated magnesium-aluminum-iron silicate, vermiculite exfoliates when heated or subjected to certain chemical reactions. It is a mono-clinic crystal with pseudo-hexagonal characteristics, with a Mohs scale hardness of 1.5. The material used in these tests was a No. 4 (fine) vermiculite which weighs 10 lbs. per cu. ft. and the particle size ranges between 30 and 100 mesh. The Zonolite Company, Travelers Rest, South Carolina, generously provided this material.

[3] Oscar H. Hammer. 1943. Method for controlling parasites in soil. U. S. Patent No. 2, 419, 073, April 15, 1947.

[4] Oscar H. Hammer, 1943. Parasiticide composition. U. S. Patent No. 2, 403, 435, July 9, 1946.

Field Experiments

For field tests, Dowfume W-85 was mixed with vermiculite in drums at rates of 2 1/4 and 1 1/8 gallons per 100 pounds. It was intended to apply these materials at rates which would give the usual recommended dosages of the fumigant per acre (4 1/2 gallons broadcast and 2 1/4 gallons in the row). The materials actually were applied at one half the recommended dosage, however, due to an oversight at the time of application. Application was made with an "Ezee-Flow" fertilizer distributor modified by attaching the flexible rubber tube of the distributor to the back of a James-type shoe[5], mounted on a metal frame. This made possible the placement of the mixture in the soil in a band approximately 1 inch wide and at a depth of 6 inches. The land was prepared for planting about three weeks after the broadcast treatment was applied. Following row treatment, the land was ridged immediately and was left undisturbed until time to transplant. With row treatments, three different methods of fertilizer application were used, as follows: 1) the fertilizer was applied separately in the row at the time of treatment, 2) the fertilizer and the fumigant mixture were mixed and applied together, and 3) the fumigated ridge was opened, the fertilizer applied, and the row was again ridged just prior to transplanting.

Plots were 0.1 acre in size, consisting of 10 rows. With the broadcast treatment, the whole plot was treated. In the row-treatment plots, however, rows 1, 2, 5, 6, 9, and 10 were treated and rows 3, 4, 7, and 8 were left as checks, giving a total of six treated and four non-treated rows in each plot.

Three weeks after treatment, Dixie Bright 101 tobacco plants were planted and allowed to grow to maturity. The crop was not harvested. A total of 20 plants from treated rows and a like number from non-treated rows in each plot were then pulled at random, examined, and rated for root-knot severity on a 0 to 5 scale. A root knot index was then computed according to the following class values: 0 = 0 (no root knot); 1 = 10 (trace); 2 = 25 (slight); 3 = 50 (moderate); 4 = 75 (severe); and 5 = 100 (severe root knot with partial root decay).

Results: Table 1 shows results of field treatments using ethylene dibromide-vermiculite mixtures. No control was obtained with the broadcast treatment. Practical root knot control was obtained with row applications except in the treatment where the fertilizer and fumigant

Table 1. The effectiveness of ethylene dibromide-vermiculite mixtures in controlling the root-knot nematode (Meloidogyne spp.).

Treatment			Root-knot index[a]	Notes
Vermiculite pounds	EDB gal./A	Method		
200	2.25	Broadcast	78.8	No control
CK	----	--	71.3	
50	1.12	Row[b]	41.3	Fair
CK	----	--	70.0	
50	1.12	Row[c]	35.3	Good
CK	----	--	83.8	
100	1.12	Row[b]	43.8	Fair
CK	----	--	71.3	
100	1.12	Row[c]	36.0	Good
CK	----	--	71.3	
100	1.12	Row[d]	65.0	Poor
CK	----	--	88.8	

[a] See text
[b] Ridge reopened and fertilizer applied just before transplanting.
[c] Fertilizer applied separately at time of fumigation.
[d] Fertilizer and fumigant mixed and applied together.

[5] The James shoe is an opening shovel, made up of 8-inch irrigation steel with an overlapping 2-inch heavy-duty point, attached to a shank.

were mixed and applied together. The fumigant was more effective in the treatment where the ridge was not reopened than in the treatment where the ridge was reopened and fertilizer applied just prior to transplanting.

DISCUSSION AND CONCLUSIONS

Greenhouse and field tests indicate that vermiculite may be used as a carrier for ethylene dibromide. It may be effective also as a carrier for D-D, although D-D was not used in these tests. Practical root knot control resulted from certain treatments under field conditions even at the low rates used. It is probable, however, that the root-knot indices would have been even lower had the recommended rates of fumigant been applied. The failure of the broadcast treatment to control root knot was probably due to the fact that lethal dosages of fumigant were present only in very limited zones which lost their identity with subsequent land preparation. Certain row treatments, however, gave practical root knot control, indicating that an effective dosage was delivered to soil in the ridge. This was especially true in the treatments where the ridge was not reopened (root-knot indices 35.3 and 36.0). In the treatment where the fertilizer and fumigant were mixed and applied together, some difficulty was encountered in maintaining a uniform mixture of the two materials due to wide differences in their densities. This might account for the poor control of root knot in this treatment.

Vermiculite is a free flowing inert material and is easily applied to soil with an ordinary fertilizer distributor. It also has a high sorption capacity for liquids, yet ethylene dibromide is apparently readily released from it in the soil as evidenced by effective root knot control and absence of phytotoxicity following its use.

The use of soil fumigants in a manner herein described would offer several practical advantages over the application of liquids. It would make the operation as simple as applying fertilizers and eliminate the necessity for the special types of applicators now in use. It would fill the need of the average home gardener confronted with nematode control on vegetable and ornamental crops. While the preliminary trials with vermiculite have shown promise, much more information is needed before practical procedures can be developed. This involves the comparison of different types and grades of carriers, the optimum proportions of active fumigant and carrier, the problems of packaging and handling to avoid excessive loss of toxicant through evaporation, etc. Further studies are in progress.

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TECHNIQUE FOR INDEXING RED RASPBERRY PLANTS FOR VIRUSES

Glenn A. Huber[1]

A convenient method for the determination of viruses in red raspberry plants has been developed in connection with the certification program established by the Division of Horticulture, Washington State Department of Agriculture.

The method consists of indexing red raspberry plants growing in the field onto potted black raspberry seedlings, variety Cumberland, held under controlled conditions in the greenhouse or screenhouse.

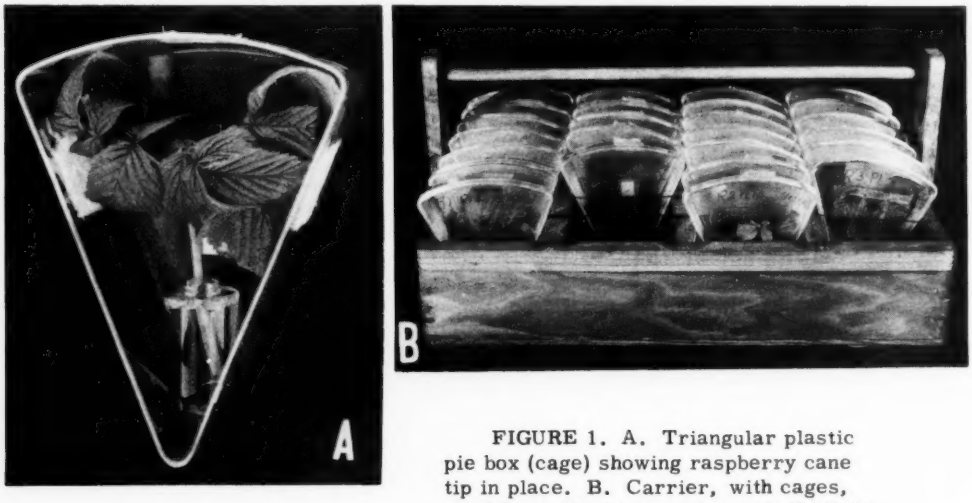

FIGURE 1. A. Triangular plastic pie box (cage) showing raspberry cane tip in place. B. Carrier, with cages, used for collecting specimens in the field.

A young leaf or cane tip is removed from the plant to be indexed (donor) and placed in a specially constructed cage. The cage is a triangular plastic pie box with 1/4-inch holes made in the sides for ventilation. These holes are covered with voile cloth to prevent the escape of aphids. A 1-inch vial is placed in the inverted apex of the pie box and held in place by a cork disc glued to the back of the container. The vial is filled with water before being taken to the field. The leaf petiole or base of the cane tip is placed in the vial and the cage is labeled to correspond with the donor in the field (Fig. 1 A).

Cages are transported by means of a carrier. The type of carrier used by the State Department of Agriculture accommodates 24 cages (Fig. 1, B).

Leaves and cane tips may be held in the cages in excellent condition for several weeks by refilling the vials with water daily. A weak nutrient solution may be used instead of water.

The cages containing the leaves or cane tips of the donors are taken to the laboratory or greenhouse, placed on racks, and infested with virus-free aphids, Amphorophora rubi Kalt., which have been reared on black raspberry seedlings. The aphids, usually 15 to 20 per cage, are permitted to feed on the donor for 144 hours, after which they are transferred to young Cumberland black raspberry seedlings growing in 4-inch pots. They are allowed to feed on the indicator plant for 144 hours. The aphids are confined to the indicator plant by means of a ventilated plastic bag placed over the plant and rim of the pot and held in place with a rubber band. Black raspberry seedlings having three to four true leaves have proved most satisfactory.

The plastic bags are removed at the end of the feeding period and the aphids are killed by spraying with Metacide. The most recent practice for killing the aphids has been to water the pot with a solution of Systox 12 hours before removing the bag. This process of killing the aphids is not only more convenient but also kills and protects the indicator plant from 2-spotted mites that often become established and produce symptoms that interfere with virus readings.

[1] Plant pathologist, Division of Horticulture, Washington State Department of Agriculture.

Virus symptoms usually appear on the indicator plant in seven to ten days. Three readings are made at ten-day intervals.

The method has also proved very convenient in indexing strawberry plants. Tip runner plants are collected from the donors before rooting begins, leaving about 1 inch of the runner from the mother plant attached to each tip plant. The end of the detached runner is placed in the vial within the triangular plastic cage. The rest of the procedure is similar to that of indexing raspberry. Virus-free strawberry aphids, Capitophorus fragaefolii (Ckll.) Massee, are used as vectors. Fragaria vesca, East Malling strain, are used as indicator plants.

This method of indexing both raspberry and strawberry plants has been in use during the past two seasons.

WASHINGTON STATE DEPARTMENT OF AGRICULTURE

TWO WILD ROSES -- ALTERNATIVE HOSTS FOR CAPITOPHORUS FRAGAEFOLII (CKLL.), THE VECTOR OF STRAWBERRY VIRUSES

P. W. Miller and Geo. M. Darrow[1]

Wild roses (Rosa nutkana Presl. and R. rubiginosa L.) are very abundant in western Oregon and western Washington along fence rows and in pastures. In a recent survey of a considerable number of wild rose bushes in the vicinity of Corvallis, Oregon, aphids were found on practically every rose bush examined. The number of aphids per bush varied from a few to many; on most of the bushes, the aphids were moderately abundant.

Most of the aphids found resembled closely the common strawberry aphid (Capitophorus fragaefolii (Ckll.)). Collections of the aphids were made during the summer and fall of 1953 from wild roses growing along highways and fence rows in six different locations near Corvallis, Oregon and one in Washington, and sent to the U. S. Bureau of Entomology and Plant Quarantine for positive identification (Table 1.)

Table 1. Aphids collected on wild roses at seven different locations in western Oregon and western Washington, 1953.

Location	Aphid species found
1/2 mile east of Corvallis, Oregon	Macrosiphum solanifolii (Ashm.)
3/4 mile east of Corvallis	Capitophorus spp. (near C. fragaefolii)
4 miles west of Corvallis	Capitophorus sp. (near C. fragaefolii)
3 miles north of Peoria, Oregon	Capitophorus sp. (near C. fragaefolii)
3-1/4 miles north of Peoria	Capitophorus sp. (near C. fragaefolii)
3-1/2 miles north of Peoria	(1) Capitophorus sp. (near C. fragaefolii) (2) Capitophorus fragaefolii
Near Long Beach, Washington	(1) Myzus porosus (Sand.) (2) Capitophorus sp. (near C. fragaefolii)

As shown in Table 1, Capitophorus aphids resembling greatly, if not identical with, the common strawberry aphid were found on wild rose bushes in six locations. These results are in agreement with those of Palmer[2] who found the host range of C. fragaefolii in the Rocky Mountain region to include Fragaria, Rosa, and Potentilla.

Aphids collected from the six different locations near Corvallis were transferred from wild roses directly to healthy Fragaria vesca (East Malling clone) indicator plants to determine whether they were viruliferous; none of the indicator plants became infected, indicating that the aphids collected were not viruliferous. To determine whether these same aphids possess the ability to transmit strawberry viruses, aphids from two of these collections were caged on yellows-infected strawberry plants (seven aphids per plant), where they were allowed to feed for 48 hours. Then they were transferred to healthy F. vesca indicator plants. Aphids from the wild rose three miles north of Peoria, Oregon, (about four miles northeast of Corvallis) did not transmit virus to four plants of F. vesca, but aphids from the wild rose four miles west of Cor-

[1] Pathologist, and Principal Horticulturist, respectively, Agricultural Research Service, U. S. Department of Agriculture.

[2] Miriam A. Palmer, 1952. Aphids of the Rocky Mountain region. Thomas Say Foundation, Denver. 452 p. (Entomological Society of America) Thomas Say Foundation (Publications) v. 5).

vallis transmitted virus to two plants of F. vesca. It would appear from these results that at least some of the aphids present on wild roses in Oregon are able to transmit strawberry viruses.

If wild roses prove to be important alternative hosts of strawberry aphids, they will be a factor in a successful vector-control program. Wild roses are abundant near many cultivated strawberry fields in both Oregon and Washington.

U. S. DEPARTMENT OF AGRICULTURE, AGRICULTURAL RESEARCH SERVICE, IN COOPERATION WITH THE DEPARTMENT OF BOTANY AND PLANT PATHOLOGY OF THE OREGON AGRICULTURAL EXPERIMENT STATION.

DEMATOPHORA ROOT AND CROWN ROT OF STRAWBERRY

Stephen Wilhelm[1], Robert D. Raabe[2], and H. Earl Thomas[3]

Collapsed and dead strawberry plants were observed in a planting of the Shasta variety in Santa Cruz County of California on land recently cleared of old apple trees. The distribution of affected plants was erratic. The causal agent of the disease was determined by isolations and greenhouse inoculations to be the fungus Rosellinia (Dematophora) necatrix (Hart.) Berk., the same fungus which had caused the death earlier of some of the apple trees. Strawberry is a new host[4].

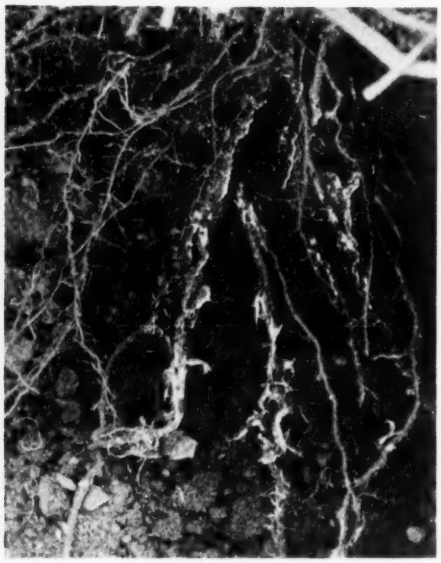

FIGURE 1. White mycelium of Dematophora necatrix on roots of affected strawberry plant in the field.

The fungus pervades the cortex, cambial zone and wood of the roots and crown bases, forming indefinite plaques of white tissue in the cambial zone. These plaques are similar to, but do not attain to the well defined mycelial fans produced by the oak root fungus Armillaria mellea (Fr.) Quel., in strawberry. Cottony mycelial growth often grows into the surrounding soil of the roots for a short distance if sufficient moisture is present. (Fig. 1). The mycelium is composed in part of hyphae with distinct pear-shaped swellings at the septa. This character is useful in diagnosis. Though the disease is exceedingly destructive to plants attacked, the losses throughout the field after one year have not been severe, the foci of disease probably coinciding with old invaded apple roots. These old roots probably serve as food bases from which mycelial growth through the soil and penetration of sound roots can proceed.

The field in which this outbreak occurred had been fumigated prior to planting with 30 gal. per acre of CBP-55 (Shell chlorobromopropene) (2) applied in two 15 gal. per acre treatments. However, earlier tests by Wilhelm and Abdul Hamid Kahn (unpublished) showed that D. necatrix was exceedingly resistant to soil fungicides, possibly excepting allyl bromide, withstanding, for instance four to five times the amount of chloropicrin required to kill Verticillium albo-atrum Reinke & Berth. It is therefore doubtful that the treatment had appreciably reduced the amount of the Dematophora fungus present.

D. necatrix has been recognized in Europe as a destructive root pathogen of fruit trees for many years. It was first recognized in California in 1929 in Santa Cruz County. A summary of its host range and spread since its introduction into California has been published recently (1).

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1. Thomas, H. Earl, Stephen Wilhelm, and Neil A. MacLean. 1953. Two root rots of fruit trees. U. S. Dept. Agr. Yearbook 1953: 702-705.

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[1] Assistant Plant Pathologist, Department of Plant Pathology, University of California, Berkeley.
[2] Junior Plant Pathologist, Department of Plant Pathology, University of California, Berkeley.
[3] Plant Pathologist, Department of Plant Pathology, University of California, Berkeley.
[4] Unreported tests conducted by Dr. Harold E. Thomas prior to 1945 showed that strawberry was susceptible to the Dematophora disease upon inoculation, but this is the first appearance of the disease in the field so far as the writers are aware.

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VERTICILLIUM WILT OF SWEET CHERRY IN BRITISH COLUMBIA[1]

D. L. McIntosh

During the 1953 season, Verticillium dahliae Kleb. was isolated from a number of three-year old sweet cherry seedlings growing on the Experimental Station, Summerland, British Columbia. This is not the first time that this wilt disease has been recognized in this area, but the symptoms exhibited by some of the affected trees examined in 1953 were unlike those described previously.

Out of 220 trees in this block, 202 were affected, and considerable variation in disease expression was observed. In general, symptoms appeared first in the one-year old wood, in most cases as a wilting of the leaves of one or more spurs of the leader (Fig. 1). Affected leaves were usually a faded green color, with yellowing occurring only infrequently. There was a progressive increase upward in the number of spurs affected until the one-year wood of the central stem in many trees was completely defoliated by the end of August. This defoliation of the leader often occurred before any marked symptoms appeared in either the lateral branches or the current year's growth (Fig. 2). All of the affected trees had been in good vigor prior to the appearance of the disease symptoms, and had developed up to about four feet of terminal growth. No ground crops had been grown on this land at any time, as it had been maintained as a stone fruit planting in weed cover.

FIGURE 1. Photograph taken August 5, showing several wilted leaves on spurs of the leader.

FIGURE 2. Tree shown in Figure 1 photographed September 1. The one-year wood of the leader is defoliated, but no marked symptoms are evident in the lateral branches or current years's growth. Verticillium was isolated from this tree. (Photographs by S. R. Cannings)

Variations from the above syndrome occurred. In some trees, disease expression was

[1] Contribution No. 1345 from the Botany and Plant Pathology Division, Science Service, Department of Agriculture, Ottawa, Canada.

merely a slight rolling upward and inward of the margins of leaves on the one-year wood. In these cases, many of the leaves remained attached to their spurs throughout the season with the only increase in the severity of wilt expression being a premature appearance of fall coloring. In other trees exhibiting only leaf-rolling symptoms initially, considerable defoliation had occurred by the end of the summer. Progressive stages in symptom development were seen in single leaders, with shedding of leaves at the base, wilting and discoloration of the leaves above, and upward curling of the leaf margins at the top of the one-year wood. The syndrome in other trees resembled more closely that described by van der Meer (1), with rapid yellowing, wilting, drying and shedding of the leaves from affected limbs. Disease expression frequently progressed upward rather than laterally, with the central leader and current year's growth at the top often being defoliated before any marked effect was evident in the lateral branches.

The intensity of discoloration in the vascular system of affected limbs varied from light to dark brown or black, depending upon the severity of symptoms displayed externally. Verticillium was isolated from branches of trees showing all types of wilt symptoms, and in a few instances from spurs with wilted leaves, but not from leaf petioles.

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AN EVALUATION OF COPPER 8-QUINOLINOLATE AS A FUNGICIDE AGAINST SOME POME FRUIT DISEASES

Dwight Powell[1]

Copper 8-quinolinolate (Bioquin 1) has long been recognized as a very effective organic fungicide. It was first tested in the field for the control of apple scab and blotch in 1946 (5). Laboratory toxicity tests with various derivatives of Bioquin 1 were reported in 1948 (2). Comparisons were made of some 8-quinolinol derivatives against the apple scab fungus under both laboratory and field conditions (3). Its efficacy in controlling tomato diseases was evaluated in 1949 (1). It was not considered outstanding for the control of brown-rot blossom blight on peaches (6) but was very effective in preventing preharvest infection (4). The use of Bioquin 1, however, has been restricted primarily to non-agricultural fields because of its excessive cost. Recently there has been a resurgence of interest in this chemical and the writer has received many requests for data on its efficiency in controlling various plant diseases. It is hoped that the following information will be of some value in the further development of this chemical as a fungicide.

Blotch (Phyllosticta solitaria)[2]. Bordeaux mixture starting at the second cover spray was the standard blotch treatment prior to the advent of the less phytotoxic organic fungicides such as ferbam. The latter when used in the prebloom period prevent the primary infections of the current year's twig growth, thus greatly reducing the amount of inoculum in succeeding years. Table 1 gives the results of observations in 1946 and 1947 on trees sprayed during the preceding years.

Table 1. Control of blotch cankers on new twig growth of Duchess.

Treatment/100 gal.	Sprays applied	Number of cankers on 100 inches of new growth	
		After 1946 season	After 1947 season
Ferbam, 1 lb.	Pink, calyx, 1st & 2nd cover	1	9
Bioquin 1, 1/2 lb.	Pink, calyx, 1st & 2nd cover	0	18
Wettable sulfur, 8 lb. Bordeaux, 4-6-100	Pink, calyx, 1st cover; 2nd & 3rd covers.	25	90
No treatment		29	110

It was evident that Bioquin 1 was extremely effective in reducing blotch lesions on the twigs but was not superior to ferbam.

Over a four year period Bioquin 1 was compared with other treatments for the control of blotch infection on the fruit (Table 2).

From the data given it was concluded that while Bioquin 1 was not quite as effective as ferbam, it did give good commercial blotch control. Of particular interest was the Bioquin 1-sulfur combination which not only performed equally as well as the higher concentrations of Bioquin 1 alone but approached the competitive price range of the commercial fungicides.

[1] Appreciation is expressed to the Monsanto Chemical Company for supplying materials and funds necessary for this work.

[2] In all field tests spray applications were made with a conventional hydraulic sprayer using either single nozzle guns or four nozzle brooms. All sprays were in the dilute form and the recommended insecticides were mixed, when needed, to the fungicide treatments. To secure proper dispersion Bioquin 1 (100% active) was mixed with a small amount of 70% alcohol before being added to the spray water.

Table 2. Control of blotch infection on Duchess fruit in commercial orchard tests.

Treatment/100 gal.[a]	Percent of fruit infection at harvest			
	1946	1947	1948	1949
Ferbam, 1 lb.	2.0	3.0	.5	.1
Bioquin 1, 1 lb.	1.8	3.3	.4	.3
Bioquin 1, 1/2 lb.	4.0	5.6	.6	1.7
Bioquin 1, 1/4 lb.; Sulfur, 3 lb.	---	---	.9	1.8
No treatment	46.0	50.0	21.0	24.0

[a] Sprays were applied in the pink, calyx, 1st, 2nd, and 3rd cover sprays.

Bitter Rot (Glomerella cingulata). In 1946 it was demonstrated that Bioquin 1, 1 lb. to 100 gals. in one application stopped bitter rot advance, whereas in adjoining plots of Bordeaux 4-6-100 and ferbam 2 lbs. to 100 gals. infection developed to the 10 percent and 20 percent levels, respectively. Bioquin 1 was superior to the other materials in that it did not leave a visible residue on the fruit at harvest. In 1949 repeated applications of Bioquin 1, 1/4 lb. to 100 gals. in the third, fourth, and fifth cover sprays prevented bitter rot infection, as compared to a 7 percent build-up in an adjoining block where it was not used. In another orchard in 1949, Bioquin 1, 1/2 lb. to 100 gals. in two applications seven days apart starting with the first appearance of infection, eradicated the old infections and completely prevented further development of the disease.

Cedar Rust (Gymnosporangium juniperi-virginianae). In 1947 an orchard of 25-year-old Jonathan trees bordered by redcedar trees was divided into three large blocks. One block received Bioquin 1, 1 lb. to 100 gals., the second block ferbam 1 lb. to 100 gals., in the pink, full bloom, calyx, and first and second cover sprays. The third block was given the standard wettable-sulfur fungicide schedule. On July 3, a fruit count showed no cedar rust in the ferbam block, in the Bioquin 1 block 10 percent fruit infection, and in the sulfur plot 72 percent fruit infection. Thus, although Bioquin 1 gave good control it was inferior to ferbam and much more costly.

Scab (Venturia inaequalis). The efficacy of Bioquin 1 in controlling apple scab is apparent from the data in Table 3. The data for 1947 and 1948 have been reported previously (7).

The Bioquin 1-sulfur combination performed comparably to the other commercial fungicides and was definitely superior to the full strength sulfur program. In addition to the above tests, large plots were arranged in commercial orchards in 1948 and 1949, and in every case the Bioquin-sulfur schedule gave excellent commercial control of scab.

Fabraea Leaf Spot (Fabraea maculata). In 1947 Bioquin 1, ferbam, and wettable sulfur were compared for leaf-spot control in a forty-acre block of Kieffer and Garber pears. The results are shown in Table 4. Bioquin 1 proved to be as efficient as the other materials. Defoliation from Fabraea leaf spot had been a serious problem in this orchard in previous years and it is interesting that the moderate schedule employed was so effective.

Miscellaneous diseases. Many field tests comparing Bioquin 1, 1 lb. to 100 gals., with other materials were conducted against fire-blight (Erwinia amylovora) of apple and pear. While it did partially control fire-blight infections it was never as efficient as Bordeaux mixture (2-4-100). In 1949, sooty blotch (Gloeodes pomigena) and fly speck (Leptothyrium pomi) were adequately controlled with Bioquin 1, 1/4 lb. to 100 gals., when applied in the third, fourth, and fifth cover sprays on apple. There was no evidence that Bioquin 1 either would or would not

Table 3. Comparative tests with Bioquin 1 in controlling apple scab over a four-year period.

Treatment/100 gal.[a]	Percent fruit infection at harvest			
	1947	1948	1949	1950
Captan (50%), 2 lb.	----	----	----	5.2
Bioquin 1, 1/2 lb.	37.8	27.3	----	----
Bioquin 1, 1/4 lb.; Sulfur, 3 lbs.	----	16.4	2.8	10.1
Ferbam (76%), 1 1/2 lbs.	49.4	20.4	----	11.8
Crag 341, 1 qt.	47.6	51.0	2.6	9.0
Puratized Agricultural Spray, 1 pt.	28.2	14.3	4.1	8.3
Wettable sulfur, 8 lbs.	34.6	37.8	3.7	17.0
Unsprayed check	100.0	89.2	32.5	65.0

[a] Treatments applied in all sprays starting with the prepink and ending with the 2nd cover.

Table 4. Pear leaf-spot test in 1947.

Treatment/100 gal.[a]	Percent leaf-spot		
	May 27	June 10	July 23
Bioquin 1, 1/2 lb.	0	1.4	1.7
Ferbam (76%), 1 1/2 lb.	0	.9	.8
Wettable sulfur, 8 lb.	0	.7	2.6
Unsprayed check	4	11.0	38.0

[a] Sprays were applied at the calyx, 1st, 2nd, and 3rd cover periods.

control frogeye leaf-spot or black rot. (Physalospora obtusa).

Phytotoxicity. Bioquin 1, 1/4 lb. to 100 gals., with or without sulfur, is considered extremely safe to use on the most tender fruit foliage. The 1/2 lb. to 100 gals. concentration was non-injurious in the above tests but might cause slight fruit russet to Golden Delicious under some climatic conditions. The 1 lb. to 100 gals. dosage will usually give a typical copper injury although in the test on pears no injury was noted.

Summary. Bioquin 1 was compared with a number of commercial fungicides in field tests on apples and pears. It was excellent against bitter rot, fly speck and sooty blotch; good against apple scab, apple blotch, and Fabraea leaf-spot; and fair in the control of cedar rust. It was not satisfactory in controlling fire-blight. At concentrations suitable for disease control Bioquin 1 was not phytotoxic.

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NUT DISEASES IN OREGON IN 1953

P. W. Miller[1]

DISEASES OF WALNUT

Walnut Blight (Xanthomonas juglandis). Walnut blight was widely distributed in Oregon in 1953, causing greater economic loss than in 1951 or 1952. Losses in non-sprayed orchards varied, according to the locality, from a small amount up to 35 percent. For the State as a whole, it is estimated that about 10 percent of the potential Oregon walnut crop was destroyed by this disease in 1953.

Mushroom Root Rot (Armillaria mellea). Mushroom root rot caused the decline and death of a limited number of Persian walnut trees grafted on black and Persian walnut rootstocks in 1953. In general, the incidence of the disease was greater in upland orchards and in those on poorer soil types than in orchards in the river bottoms and on better soils.

Leaf Scorch (non-parasitic). This leaf disorder was widely distributed in western Oregon in 1953, occurring to a greater or less extent in most Persian walnut orchards there.

Downy Spot (Microstroma juglandis). This leaf spot occurred in limited amounts in a few walnut orchards in the Willamette Valley in 1953. It was of no economic importance, however, since it did not cause any defoliation or decrease the functional leaf area to any significant extent.

Crown Rot (cause undetermined). A crown and root-rot of undetermined cause was found affecting a limited number of Persian walnuts grafted on Hinds black walnut rootstocks and Persian seedling walnuts.

Black-line (Girdle) of Grafted Walnuts (non-parasitic). Black-line was responsible for the death of more grafted Franquette walnut trees in 1953 in Oregon than any other single cause. Its importance in the decline of grafted walnuts in this State was indicated by the results of an individual-tree survey made in 1953 in 36 widely scattered walnut orchards, including over 11,000 trees. In these 36 orchards, 2464 trees were found declining, 53.9 percent from the effects of the black-line disorder. This trouble was widely distributed in Oregon, occurring to a greater or less extent in practically all walnut districts in the western part of the State. In general, incidence was greater in upland than in the river bottom orchards. All trees found affected were of the Franquette variety grafted on Hinds black walnut (Juglans hindsii) rootstocks or on hybrids of other species with this one. Not a single case of the disorder was found in Persian walnuts grafted on Persian walnut rootstocks.

Perforation (non-parasitic). This disorder, which is characterized by the presence of thin spots or small holes in the shell, usually at the blossom end, was present in limited amounts in 1953 in some Persian walnut orchards in the Willamette Valley.

DISEASES OF FILBERT

Bacterial Blight (Xanthomonas corylina). Bacterial blight was widely distributed in western Oregon in 1953, occurring to a greater or less extent in most filbert orchards in the State. It was most prevalent in the northern part of the Willamette Valley in older orchards, where it caused the death of many small twigs and branches.

Mildew (Phyllactinia corylea). Mildew occurred to some extent in many filbert orchards in western Oregon in 1953. However, it was of no economic importance as it did not make its appearance until the end of the season, and the leaves persisted on the trees until time of normal leaf fall.

Brown Stain (non-parasitic). This disorder, characterized by the exudation of a brownish liquid from the shell and by abortion of the embryo, was present in greater than normal amounts in 1953 in orchards in the Pacific Northwest. Crop losses due to it ranged from less than 1 to 10 percent, the estimated average loss being about 2 percent.

Filbert Shrivel (non-parasitic). Filbert shrivel, characterized by a failure of the embryo to develop, was present in greater than normal amounts in practically all filbert orchards in Oregon in 1953. In certain Barcelona plantings, over 35 percent of the crop was affected with this disorder. For the State as a whole, it is estimated that approximately 20 percent of the 1953 crop was lost from this disorder -- one of the highest losses on record.

U. S. DEPARTMENT OF AGRICULTURE, AGRICULTURAL RESEARCH SERVICE, IN COOPERATION WITH THE DEPARTMENT OF BOTANY AND PLANT PATHOLOGY OF THE OREGON AGRICULTURAL EXPERIMENT STATION

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OBSERVATIONS ON LATE BLIGHT AND OTHER POTATO DISEASES IN PERU[1]

John S. Niederhauser[2]

During March 1953, the writer had an opportunity to visit several of the important potato-growing areas in the Peruvian Andes. The main potato crop in this region is planted in October and November and harvested in May and June. This is the rainy season, and also that part of the year when frosts are least likely to be ruinous. The principal varieties planted are included in the species Solanum andigenum (or S. tuberosum subsp. andigenum), and take from five to six months to mature. During my visit in March, October-planted potatoes were in full bloom and had attained what was probably their maximum vegetative growth.

LATE BLIGHT (Phytophthora infestans)
(Known as "rancha" in the Peruvian highlands, and as "hielo" on the coast)

Highlands (Sierra): Late blight has been well advertised as one of the most serious problems for the potato grower in the Peruvian highlands. It was therefore a surprise to find so little late blight in this area, especially since there was more rainfall than usual during the year. In the Huancayo, Cuzco, and Puno areas only susceptible varieties are grown. These had been growing in the field from four to five months, with little or no protection against blight, and yet foliage lesions were hard to find. Only the more progressive farmers had sprayed more than two or three times, and the fungicide applications were made with small knapsack sprayers applying only 30 gallons per acre (when the plants are small) up to 120 gallons per acre (when the plants are very large and the danger is considered great). Four or five applications made at 15- to 20-day intervals are generally adequate for good blight control. Failure to control late blight is regarded as pure negligence.

While foliage blight in the Peruvian sierra was not a serious problem, farmers said that tuber rot sometimes caused great losses. Once tuber rot appeared in a lot of potatoes, the owner usually had to sell at a considerable discount. Therefore, farmers would watch their fields carefully, and at the first sign of tuber rot would cut the vines, dig the potatoes, and get them to market. Apparently the small amount of foliage blight was a reservoir of inoculum from which the spores were washed down into the tubers, and this tuber inoculation could occur over a period of several months.

It is probable that the relatively light foliage attack by P. infestans is due to the low mean temperatures at the higher elevations (12,000 to 14,000 feet) where many of the potatoes are grown. At Huancayo the average mean temperature during the growing season is 10° to 11° C. (50° to 52°F.), and at Puno it is even lower, 8° to 10° C. (46° to 50°F.). Minimal night temperatures are near freezing throughout the growing season. The blight organism is apparently able to maintain itself but not to spread rapidly. Perhaps the high amount of tuber rot is due to the more constant and somewhat higher temperature of the soil.

At Huancayo, Ing. Carlos Ochoa has several blight-resistant selections which are now being increased for distribution. This resistance is partial and not complete under Peruvian conditions. Ing. Ochoa was of the opinion that frost resistance is of more importance in the Peruvian highlands than late-blight resistance.

Lower Elevations (Montañas): Foliage blight was severe at Patambuco, which is about 9,300 feet high and 100 miles east of Puno. Patambuco is not, however, an important potato area, being considerably warmer than the highland area where the main potato crop is produced.

Late blight was severe in another lower (10,000 feet) potato-growing area known as Marcapata, located about 150 miles from Cuzco. Marcapata is near the lowland area, and is situated on the "brow of the mountain" or "ceja de montaña," where the average mean temperature is considerably higher than at Cuzco.

In the region near Arequipa we saw very severe foliage blight, and here unsprayed fields were completely dead. A demonstration spray program, conducted by the local office of the federal extension service, was very successful in showing the value and necessity of preventive

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[1] Journal Series Paper No. 10 of the Mexican Agricultural Program of The Rockefeller Foundation.
[2] Plant Pathologist with the Mexican Agricultural Program of The Rockefeller Foundation.

spray applications. They were using Pyrenox and Dithane, and both were giving excellent control.

We were told that late blight appeared in the Arequipa area for the first time in 1949, although potatoes had been grown there for many years. Previously no fungicide spraying was done. Since then blight has been severe every year, and the acreage near Arequipa planted to potatoes has dropped from around 7,000 to about 1,200 acres. This great reduction is due entirely to fear of late blight.

At Arequipa the Servicio Agrícola had planted a few tubers each of some varieties and selections sent to Peru by Dr. F. J. Stevenson, principal potato geneticist of the United States Department of Agriculture. There were also some European potato varieties sent from Holland. Following is a list of the varieties and lines seen, according to their blight reaction at Arequipa:

No Blight Observed	Blight Susceptible
Essex	Sebago
Kennebec	Pontiac
Cherokee	Voran
Pungo	Alpha
B 922-6	Libertas
B 595-76	Gineke
B 606-67	Gloria
B 75-4	Wilpo
X 96-56	Salamanca (local variety)

These data would indicate that race "1"[3] does not exist at present in the Arequipa area.

Coastal Area (Lima): No potatoes were being grown on the coast during March. Potatoes are planted there in May and June and are grown during the winter season when little or no rain falls but the relative humidity is at or near 100 practically every day. Late blight is said to be devastating at this time unless adequate control measures are taken.

OTHER DISEASES

At Puno, early blight (Alternaria solani) was fairly common, appearing at about the time the potatoes flowered. Early blight here was more of a foliage problem than late blight.

In the markets in the highlands the following tuber diseases were observed:

1) Silver scurf (Spongospora subterranea), locally called "roña." This disease caused no damage to the yield, but made the product less desirable commercially.
2) Wart (Synchytrium endobioticum), locally called "verruga." This disease is widespread in the Peruvian Andes, and in at least a few cases had caused severe commercial losses.
3) Rhizoctonia solani. Judging only from the abundant sclerotia on some tuber lots, this organism is well established in the highland soils.
4) A tuber disease called "el corcho," probably the "buba disease" caused by Thecaphora solani. Though not common, the unsightly lesions in the flesh of the tuber, make this a disease to be feared by the grower and by the buyer.

No reliable estimate could be made as to how common each of these tuber pathogens was at harvest.

Virus diseases were not prevalent in the highlands. Some leaf roll and at least two types of mosaic were seen in low percentages. Virus diseases are said to be much more serious when seed from the coast is planted, and it is for this reason that the farmers on the coast import their seed from the highlands every year.

MEXICAN AGRICULTURAL PROGRAM OF THE ROCKEFELLER FOUNDATION

[3] This is race "1" of the new international classification; it is identical with Mills's "D" race and Black's "B_1" race.

BACTERIAL LEAF SPOT OF PEPPER IN DELAWARE[1]

R. S. Cox

According to unpublished reports by Heuberger (2), bacterial leaf spot of pepper, caused by Xanthomonas vesicatoria, is of sporadic occurrence in Delaware. During years when the disease was severe (two out of seven during the period 1946-1952), he found it first on southern-grown plants. Also, pepper growers in Delaware, through the years, have tended to view with suspicion transplants from the South, believing them to be of inferior quality. This attitude could be due to the possibility that such plant stock was infected with the bacterial leaf-spot organism.

It became evident early in 1953 that the worst epiphytotic of this disease on record in Delaware was in the making. Through cooperation with H. P. Cannon & Son Company, Bridgeville, Delaware, an excellent opportunity was provided for direct comparative studies on the effect of plant source on disease development and yield.

In 1953, the H. P. Cannon & Son Company furnished seed from a common lot that had received the bichloride of mercury-thiram double treatment (1) to contractors in Georgia and New Jersey, and retained a portion of the same lot for plant production in Delaware.

Since the Company was particularly concerned with the Georgia situation, and since the Georgia contractor was anxious to produce satisfactory plants, Mr. Joseph W. Eckhardt, production manager of the H. P. Cannon & Son Company, made several trips to Georgia during the growing season. He found that the plantings were located on virgin soil in wooded territory. The Company's stock was grown, however, adjacent to other pepper and tomato plantings. Thus, the opportunity existed for possibility of infection via field dissemination, provided the adjoining pepper and tomato plantings were from diseased seed.

All shipments of plants were closely examined upon arrival in Delaware. Mr. Eckhardt reported no visible evidence of leaf spot; in fact, the plants from Georgia appeared to be generally superior to those grown in New Jersey and Delaware.

The plants (Georgia-, New Jersey-, and Delaware-grown) were distributed to the growers so that many had only one of the three sources of stock[2]. This made possible direct comparisons of the effect of plant source on disease development.

By the latter part of June, it appeared that the disease was more prevalent in fields of Georgia plants. Extensive field surveys by Mr. H. O. Humphreys, fieldman of H. P. Cannon

Table 1. Severity of bacterial leaf spot of pepper and effect on yield in Delaware in 1953.

Number of fields examined	Plant source	Distance from Georgia planting	Bacterial leaf spot severity[a] at indicated survey dates						Yield[b] (baskets/acre)
			June 29	July 7	July 23	Aug. 7	Aug. 25	Sept. 16	
20	Georgia	---	4.5	4.0	4.1	3.9	4.1	4.1	246
15	New Jersey or Delaware	Less than 200 yards	1.2	2.9	3.5	4.2	4.3	4.0	252
25	New Jersey or Delaware	Greater than 200 yards	0.0	0.0	0.0	0.6	1.3	1.3	418

[a] Average disease severity of all fields surveyed on a 0-5 basis where 0 = no infection, 1 = trace, 2 = light, 3 = moderate, 4 = heavy, and 5 = severe.
[b] Average yield in 5/8 baskets of all plantings within each class.

[1] Published as Miscellaneous Paper No. 193 with the approval of the Director of the Delaware Agricultural Experiment Station. Contribution No. 59 of the Department of Plant Pathology.

[2] The Georgia plants were set out one to two weeks earlier than the New Jersey or Delaware plants.

& Son Company, and the writer were undertaken to clarify this point. Some 60 fields were selected at random for periodic observation. In addition to bacterial leaf spot incidence, information was obtained on the crop in 1952, plant source, location of field in respect to other fields of peppers, acreage and yield.

All fields planted with Georgia plants showed moderate to severe infection by June 29, the date of the first survey (Table 1). Plantings of New Jersey or Delaware stock occurring in proximity (within 200 yards) to Georgia plantings, showed an early low incidence of infection which gradually built up in severity as the season progressed. Fields of New Jersey and Delaware stock more or less isolated from Georgia plantings (distance greater than 200 yards) remained free from infection through July 23; in fact, many remained free throughout the survey period, and the average index of infection of all these fields by September 16, the date of the last survey, was only 1.3 (Table 1). In no instance did the crop grown in the previous year (1952) have any apparent bearing on disease incidence or severity. Thus, in spite of the fact that they appeared to be disease-free on arrival, the Georgia plants apparently provided the initial source of inoculum for the bacterial leaf spot epiphytotic in Delaware in 1953. Samson reached similar conclusions concerning bacterial spot of tomato in Indiana (3).

It was observed, as is commonly known, that disease severity was closely correlated with weather conditions, the disease almost disappearing during periods of hot, dry weather (thereby providing the grower with a false sense of well-being) but reappearing in full force following rainy periods. This was most strikingly illustrated after the hurricane of August 14 when the disease appeared, seemingly almost overnight, on previously disease-free plantings located as far as five miles from Georgia stock.

The results of the survey indicate that:

1. The bacterial leaf spot epiphytotic on peppers in Delaware in 1953 was the result of introduced primary inoculum from Georgia by means of transplants.
2. The previous crop had no effect on disease incidence.

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A SURVEY OF VARIETAL RESISTANCE TO BLACK STEM (SEPTORIA AVENAE) IN OATS IN EASTERN CANADA[1]

R. A. Derick[2]

Introduction

There has been considerable concern in Eastern Canada during the last three or four years at the apparent damage caused by a fungus identified as Septoria avenae Frank. The disease has been referred to as Septoria black stem; Septoria leaf blotch, or speckled blotch in the United States, and in Canada as speckled leaf blotch and culm rot.

In Canada attention has been drawn to the disease by Johnson (1) and reference made to its distribution and to the cultural characteristics of the pathogen. In the United States Meehan and Murphy (2) have described the symptoms of the disease and techniques for artificial culture of the fungus, and have indicated its distribution. Stanton (3) has pointed out the seriousness of severe attacks of the disease on the oat crop and has classed it as a major disease in wide areas of the United States.

In Canada, Septoria avenae is apparently confined largely to the eastern portions of the country. In 1951, some oat crops in eastern Ontario sustained 100 percent lodging from severe attacks. In other areas of Eastern Canada similar reports of damage were recorded. Observations during the past three or four years would indicate that this disease is becoming more widespread and damaging.

The purpose of this survey was to discover possible sources of resistance to this disease among a large number of varieties. Five different oat species were represented in the group of varieties chosen. These were Avena sativa, A. nuda, A. strigosa, A. brevis, and A. byzantina.

Material and Methods

In 1950 and 1951 a group of 50 varieties was grown at the Experimental Station, Ste. Anne de la Pocatiere, Quebec, for the purpose of recording natural infection of Septoria avenae. The varieties in this test included many named varieties some of which are in common use and a few introductions about which little is known as regards commercial value or disease resistance. Two varieties classed as Avena byzantina and two from A. strigosa species were also included in this group.

In 1953, the work was extended and 107 varieties were included in the test among which were 41 unnamed introductions of foreign origin as well as a few hybrid lines developed at Ottawa. This set of varieties was grown at five different locations in Eastern Canada namely: Ottawa, Ontario, and Macdonald College, Ste. Anne de la Pocatiere, Notre-Dame du-Lac, and Caplan, Quebec.

Results

The infection in 1950 was somewhat less severe than in 1951 at the Ste. Anne de la Pocatiere Station. Readings were taken only on leaf infection. When these readings were averaged for the two years, only four varieties could be classed as very resistant. These were as follows: C. D. 3820 (Avena strigosa), Saia C.D. 4002 (A. strigosa), C.D. 3821 (A. sativa), and Trispernia C.D. 3915. It will be noted below that the last-named was found to be susceptible at the same location in 1953.

From the 1950-51 survey, it was concluded that none of the named varieties commonly grown in Canada, nor some others originating in the United States and Europe, showed a type of resistance to Septoria avenae which would make them useful as breeding material.

The degree of infection in 1953 varied considerably between testing points. At Ottawa, it was moderate; at Macdonald College, rather light; at Ste. Anne de la Pocatiere and Notre-Dame du-Lac moderate; whereas at Caplan leaf infection was very severe but with only moderate straw damage.

Readings on degree of leaf infection were made on material grown at Ste. Anne de la Poca-

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[1] Contribution No. 178 from the Cereal Crops Division, Experimental Farms Service, Canada Department of Agriculture, Ottawa, Canada.

[2] Cereal Crops Division, Central Experimental Farm, Ottawa.

tiere and Notre-Dame du-Lac at two different stages of maturity. These readings were recorded in percent leaf infection. Nine varieties out of the total number of 107 averaged 5 percent or less leaf infection in the two tests.

Leaf infection readings at Ottawa at two stages of maturity confirmed the results at Ste. Anne de la Pocatiere and Notre-Dame du-Lac except that two varieties, one A. strigosa and one A. nuda brevis, were recorded as resistant at Ottawa but susceptible at the other two locations.

Samples of straw from each variety grown at the five locations were examined at Ottawa and classified either as resistant or susceptible. No attempt was made to estimate the degree of resistance in the straw samples. Any samples which showed darkened areas were classed as susceptible.

Following are listed the varieties in the 1953 tests at five locations which were classified as susceptible to Septoria avenae:

Abegweit	Erban	Roxton	C.D. 5344 Santa Fe x Clinton
Ajax	Exeter	Richland	C.D. 5000 Ajax x Valor x 1276
Anthony	Early Miller	Rusota	C.D. 5504 (Bulgaria)
Abundance	Fortune	Rodney	C.D. 5193 (Scotland)
Alaska	Garry	Sixty-Day	C.D. 5179 Southland
Acton	Gopher	Same	C.D. 5489 (Chili)
Ardri	Grey Winter	Scotian	C.D. 5198 James
Bambu	Gold Rain	Simcoe	C.D. 5342 Clinton x Marion
Banner	Hajira	Shefford	C.D. 5374 (Denmark)
Beacon	Joanette	Sac	C.D. 5346 Sac x Hajira x Joanette
Beaver	Lanark	Trispernia	C.D. 5498 (Chili)
Brighton	Legacy	Ukraine	C.D. 5343 Clinton x Marion
Bond	Larain	Valor	C.D. 4958 (Germany)
Black Mesdeg	Laurel	Vanguard	C.D. 5024 (Wales)
Branch	Len. 39	Victory	C.D. 4768 (Czechoslavkia)
Canuck	Mabel	Ott. 4367-122	C.D. 5334 (Scotland)
Cartier	Markton	Ott. 3928-5-7	C.D. 4577 Colo
Clinton 59	M.C. 433	Ott. 3932-16	C.D. 5502 (Bulgaria)
Cherokee	O.A.C. 72	Ott. 4228-5	C.D. 928 (Russia)
Dasix	O.A.C. 3	Ott. 4230-64	C.D. 390 (Hungary)
Eagle	Onward	Ott. 4274-37-4	

A few varieties, listed below, were classified as moderately resistant at one or two locations but susceptible at the others. It is possible that these should have been classed as susceptible.

Clintafe	C.D. 5016 (Holland
C.D. 5350 Craig	C.D. 5517 (Chili)
C.D. 5023 (Wales)	C.D. 3788 (Chili)
C.D. 5495 Lelina	C.D. 5485 (Chili)
C.D. 1025 (Denmark)	C.D. 1020 (Germany)
C.D. 932 (Wales)	C.D. 966 (Scotland)
	C.D. 068 -

The following varieties were classed as resistant at all five locations:

C.D. 3820 A. strigosa	C.D. 1030 A. sativa
Sais A. strigosa	C.D. 1002 A. brevis
C.D. 5022 A. sativa	C.D. 1007 A. strigosa
C.D. 1024 A. nuda	C.D. 1017 A. nuda brevis
C.D. 4090 A. sativa	C.D. 1019 A. nuda brevis
	C.D. 920 A. brevis

It will be noted that three of the eleven varieties classified as resistant belong to A. sativa. Following is a brief note on the origin and kernel type of these varieties.

C.D. 5022: Received from Wales in 1950. It has rather an attractive medium short white kernel and is reported to be resistant to mildew.

C.D. 4090: This was also received from Wales and is similar to C.D. 5022 in having an attractive plump white kernel.

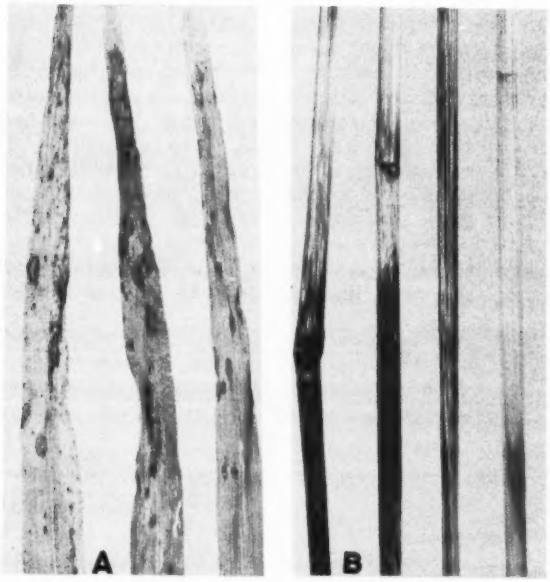

FIGURE 1. Septoria avenae on oats. A, leaf infection. B, straw infection.

C.D. 1030: Received from Germany in 1929, has slender dark brown unattractive kernels.

Thanks are due to the following for assistance in carrying on the Septoria tests from which useful information has been obtained:- Agronomy staff at Macdonald College, Que., Mr. F. M. Gauthier, Experimental Station, Ste. Anne de la Pocatiere, Que., Mr. L. J. Coulombe, Plant Pathology Lab., Ste. Anne de la Pocatiere, Que., Mr. L. Bellefleur, Superintendent, Experimental Substation, Caplan, Que.

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CANADA DEPARTMENT OF AGRICULTURE, OTTAWA.

SORGHUM SEED-TREATMENT TESTS IN COLORADO

R. H. Porter

In May 1953 18 lots of smut-infested (Sphacelotheca sorghi) seed each of Leoti sorgo and Sharon kafir, untreated or treated with different chemical fungicides, were received from the Plant Industry Station, Beltsville, Maryland. The seed was planted in 12-foot rows replicated three times and 100 seeds were planted per row. The details of the experiment and the results from similar plantings at Beltsville, Maryland and Lincoln, Nebraska have been described[1]. Unfortunately the data from Ft. Collins arrived too late to be included with the results from these stations and therefore are given here separately. They should be compared with the results from the other two stations.

Table 1. Control of covered-kernel smut in Sharon kafir and Leoti sorgo, grown from seed treated as shown, and planted in triplicate in 12-foot rows at Fort Collins, Colorado. 1953.

Treatment				Sharon kafir			Leoti sorgo		
No.	Material	Oz/bu	Form	Total heads	Smutted heads No.	Smutted heads %	Total heads	Smutted heads No.	Smutted heads %
1	Check	-	-	80	20	25.0	124	15	12.1
2	Arasan S.F.X.	1.5	Slurry	95	0	0	124	0	0
3	Phygon	1.	Slurry	99	0	0	139	0	0
4	Mycon	1	Slurry	67	0	0	87	0	0
5	Orthocide	1	Slurry	99	0	0	117	0	0
6	P-5025	1	Liquid	101	0	0	103	0	0
7a	Helixin	2.5	Liquid	62	0	0	-	-	-
7b	Actidione	1	Slurry	-	-	-	157	1	0.6
8	Vancide 51	4	Liquid	114	0	0	166	0	0
9	Ceresan M	0.5	Slurry	75	0	0	101	0	0
10	Check	-	-	77	13	16.9	119	29	24.7
11	Ceresan M2X	0.25	Slurry	104	0	0	110	0	0
12	Agrox	0.5	Slurry	106	0	0	147	4	2.7
13	Panogen	0.75	Liquid	97	0	0	141	0	0
14	Setrete	0.5	Liquid	125	0	0	93	0	0
15	Mercusol	0.5	Liquid	111	0	0	137	2	1.4
16	Pura C-4-10	1	Dust	89	0	0	101	0	0
17	Pura C-13-1212	0.5	Dust	86	0	0	139	0	0
18	N.P. 1083	1.5	Dust	78	3	3.8	137	0	0

COLORADO EXPERIMENT STATION, FORT COLLINS, COLORADO

[1] Leukel, R. W. and Webster, O. J. 1953. Sorghum seed-treatment tests in 1953. Plant Dis. Reptr. 37: 585-586.

SOYBEAN DISEASES IN IOWA IN 1953

John Dunleavy

Bacterial blight (Pseudomonas glycinea), bacterial pustule (Xanthomonas phaseoli var. sojense), stem canker (Diaporthe phaseolorum var. batatatis), Phyllosticta leaf spot (Phyllosticta glycineum), and Fusarium blight (Fusarium oxysporum) were disesases causing moderate to severe damage to the soybean crop in Iowa in 1953.

Bacterial blight was prevalent in northern and central Iowa, where the disease appeared in many fields early in June and increased rapidly in intensity. With the onset of dry weather in July most of the heavily infected leaves dropped from the plants. In almost all cases growth was good from mid-July through August with little or no infection of new leaves.

Bacterial pustule was observed in southern Iowa from mid-July to the end of the growing season. The disease was slight in most cases with a few fields showing moderate to heavy infection.

Stem canker was first observed on August 9 in central Iowa and only occasionally during the month of August. During the week of September 14, 90 fields in 36 Iowa counties were examined for stem canker. In 42 of the fields 1 percent or more of the plants were infected (Fig. 1). As in previous years, stem canker was most prevalent in central Iowa. The greatest incidence of the disease was observed in a field in which 80 percent of the plants were infected. Many soybean plantings matured early because of prolonged drought. This fact may explain the high proportion of infected plants to those killed at the time the survey was taken.

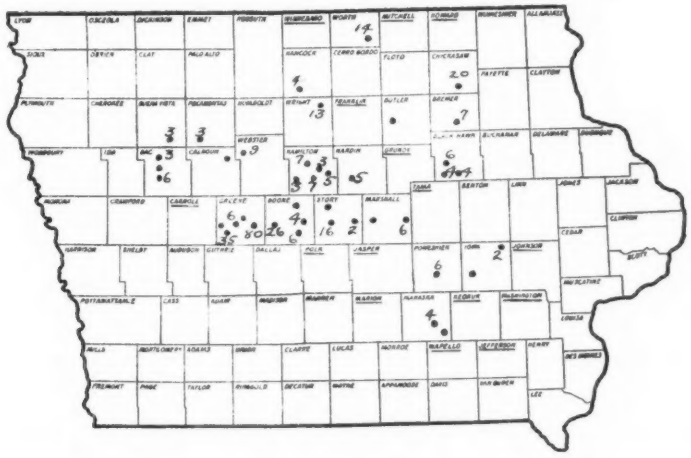

FIGURE 1. Distribution of stem canker on soybeans in Iowa in 1953. Each dot represents a field with one percent or more of the plants infected and figures represent percent of plants infected where infection was more than one percent. Counties also surveyed but in which no disease was found are underlined.

Phyllosticta leaf spot was commonly observed on young soybean plants in southern and central Iowa. It affected the primary and first few trifoliate leaves. A few soybean fields in the south central portion of the State were disked and replanted because of the severity of this disease. Plants in the replanted fields were not so severely diseased as those in the original plantings.

Fusarium blight was more prevalent than in recent years. It was usually found in one or two areas of a field and only rarely were entire fields affected.

Diseases of less importance or which were found only rarely were brown spot (Septoria glycines), brown stem rot (Cephalosporium gregatum), root and stem rot (Rhizoctonia solani), pod

and stem blight (Diaporthe phaseolorum var. sojae), downy mildew(Peronospora manshurica), wildfire (Pseudomonas tabaci), charcoal rot (Macrophomina phaseoli), and Alternaria leaf spot (Alternaria sp.). Brown spot was found early in the season on primary leaves of plants in northern Iowa. Brown stem rot was less prevalent than in previous years. Viruses infecting soybean (bud blight, mosaic, and yellow mosaic) were more prevalent than in the last five years but still were present in only trace amounts.

AGRICULTURAL RESEARCH SERVICE, U. S. DEPARTMENT OF AGRICULTURE, AND IOWA AGRICULTURAL EXPERIMENT STATION, AMES, IOWA

SECOND REPORT ON LEADER DIEBACK OF SWEETGUM[1]

Kenneth H. Garren

A destructive dieback of sweetgum (Liquidambar styraciflua L.) first attracted some attention during the summer of 1948 in Alabama and Georgia. A preliminary report (2) assigned the name "leader dieback" to this disease. Since that time the writer has observed typical leader dieback in Mississippi, western Florida, South Carolina, North Carolina, the limestone valleys of the Smoky Mountains, and as far north as Middleburg, Virginia. It has not been possible to make a first-hand comparison of this dieback with the "sweetgum blight" described by Miller and O'Brien, and Miller and Gravatt (3, 4).

Stem material averaging about 2 inches in diameter was used in the investigations leading to the first description of leader dieback (2). At that time two internal symptoms were noted: a blue-black streaked discoloration of the inner bark and youngest sapwood, and irregular broken rings of light tan discoloration throughout the sapwood. Since 1949 an attempt has been made to use only very young sweetgum stems obtained soon after the first symptoms of dieback for the isolation of possible pathogens. Blue-black discoloration has been found infrequently in this young material, but almost all of the samples have had irregular broken rings of light tan discoloration in the sapwood. It is possible that the difference in age of the stem material used originally, as compared with that used from 1950-1953, may be the reason that the blue-black discoloration has not been found frequently since 1949.

On the other hand, when sporadics are eliminated from consideration, the fungi isolated from leader dieback material have been remarkably consistent, being about 60 percent Diplodia spp., 30 percent Nectria (Tubercularia) spp., and 10 percent a black, slow-growing non-sporulating organism. The continuing prevalence of Diplodia sp. in these isolates prevents attributing the blue-black discoloration of the first report (2) to sapwood-staining action of a Diplodia sp.

On July 27, 1953 wound inoculations were made with a Diplodia and a Nectria culture grown from isolates obtained in June, 1953. Four-year-old sweetgums grown in the greenhouse were used. On September 6 a branch just above the point of inoculation with Diplodia sp. began to wilt. In 24 hours it was dead. The remainder of this leader, including three side branches, died between September 18 and 25. The Diplodia sp. was reisolated at every one-inch interval of this material. By December 10 there was no evidence of dying below the points of inoculation with Diplodia sp., nor was there evidence of any infection from inoculations with Nectria sp.

The original and the reisolated cultures of this Diplodia sp. produce pycnidia of the Lasiodiplodia type. In other cultural respects, it is different from the 1949 isolates of Diplodia sp. from leader dieback (2). The conidia are long and narrow, and dark two-celled conidia are rare.

In recording disease development, field data were collected, starting in 1949, from six different sites near Auburn, Alabama. A summary of these data are presented in the accompanying Table 1.

This table indicates that disease development was more pronounced in the period 1949-to 1951 than in the period 1951 to 1953. If DBH is used as a measurement of age, leader dieback is shown to be more destructive on younger trees. Death of younger trees prior to 1951 may explain the abrupt decrease after 1951 in importance of leader dieback in most of the areas studied.

In Alabama, dieback of sweetgum has been more spectacular on young sweetgums with their prominent leaders than on older sweetgums with their indeterminate growth. Observations on such young sweetgums have resulted in the name "leader dieback."

Sweetgums are important shade trees in many urban areas. Consequently, in studying a sweetgum disease in Maryland, observations might naturally be made on older trees. The pattern of dying in trees shown in Figures 4 and 5 in the second report on sweetgum blight (3) is typical for leader dieback, and Figures 2 and 6 show symptoms for older sweetgums found dying in the leader dieback area. The pattern of light tan discoloration found in leader dieback is quite similar to that illustrated for sweetgum blight (3, Fig. 3). The differences between symptoms reported for the two disorders (2, 3, 4) could be attributed either to differences in age of trees observed, or to differences in environment, or to both. Although the evidence is not yet conclusive, it seems possible that leader dieback (2) and sweetgum blight (3, 4) are one and the same disease.

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[1] Research on this disease is being supported by the Alabama Polytechnic Institute's Grant-In-Aid Research Program Fund.

Table 1. Development of leader dieback of sweetgum, Auburn, Alabama, 1949-1953.

Description of location	Dieback free[a] sweetgums in area in 1949		Development of the disease in terms of increase in the indicated conditions--			
			From 1949 to 1951		From 1951 to 1953	
	Number	Av. DBH	Dead Percent	Three-fourths or more of leader dead Percent	Dead Percent	Three-fourths or more of leader dead Percent
Early stage "old-field" succession	45	2	22	4	4	0
Sweetgum understory in young pine forest	143	2	21	2	2	2
Later stage "old-field" succession	103	6	5	2	2	1
Disturbed by temporary housing	58	13	4	0	0	0
Poorly drained roadside	54	7	4	15	4	12
Pasture area	41	4	0	8	10	0

[a] All sweetgums with up to 25 percent of leader dead were considered free of dieback. All sweetgums with more than 25 percent of the leader dead were tagged and were not included in these observations.

Further investigations of this disease are planned. In these plans it is to be noted that Diplodia spp. have been reported as the pathogens involved in several diebacks (6), but that the taxonomy of the genus Diplodia is confused (5). Thus the mycological aspects will be held in abeyance until pathogenicity is investigated further. The role of mineral deficiencies as predisposing factors in Diplodia-incited diebacks of Citrus (1) suggests that inoculations be made on sweetgums with artificially-induced deficiencies.

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STATUS OF SWEETGUM BLIGHT, 1953

George Y. Young, E. R. Toole, and F. H. Berry

Sweetgum blight, a disease of unknown orgin and cause, has been very common throughout much of the range of sweetgum (Liquidambar styraciflua L.) during the last two years. The disease, characterized by dying of branches from the tip and sometimes death of the tree, was first observed in 1948 in University Park, Prince Georges County, Maryland[1]. In 1952 it was described in more detail by Miller and Gravatt[2]. In addition, the leader dieback of sweetgum in Alabama, as described by Garren,[3] resembles some stages of sweetgum blight. Even before these reports were published, practicing foresters had observed the disease in various parts of the South.

This paper summarizes current knowledge about the effects, distribution, and possible causes of the blight.

Symptoms

Most of the symptoms have been carefully described and illustrated by Miller and Gravatt[2] and need not be repeated here. During 1953, however, examination of the root systems of sweetgum trees disclosed that a significantly greater number of the fine roots on diseased trees are dead than on healthy trees.

Distribution

The blight has been observed in both natural and planted stands on a wide variety of good and poor soils. Trees under 15 years of age usually seem to escape infection.

In an effort to get a comprehensive picture of the prevalence and seriousness of the blight, surveys throughout the range of the species were undertaken during 1952 and 1953. The surveyors covered more than 4,000 miles of primary and secondary roads and visited 54 States and national forests and parks.

The blight was found throughout most of the natural range of the species, but in some areas it is much more prevalent than in others. The regions most affected are 1) University Park-College Park, Maryland, and a radius of about 100 miles around this center; 2) From Columbia, South Carolina, westward and southward through Alabama, Mississippi, Arkansas, and Louisiana, to east Texas. In many locations the blight has increased decidedly in the last few years. In some places, however, there has been very little change.

Damage

The importance of the blight and the amount of damage it causes cannot yet be evaluated. In order to follow the progress of the disease and learn what losses are to be expected, a number of permanent study plots have been established in the region from Maryland to Mississippi. The plots are mostly in forest stands ranging in age from 17 to 80 years, but some are in residential areas.

When the plots were established, each tree on each plot was labeled and given a classification denoting its condition. The system of classification is as follows:

Class 0: Apparently healthy.
Class 1: Up to 1/8 of the crown affected.
Class 2: 1/8 to 1/2 of the crown affected.
Class 3: More than half of the crown affected.
Class D: Dead tree.

Although the plots have been under observation for only a short time, considerable change

[1] Miller, Paul R., and Muriel J. O'Brien. An apparently new sweetgum disease in Maryland. Plant Dis. Reptr. 35: 295-297. 1951.
[2] Miller, Paul R., and G.F. Gravatt. The sweetgum blight. Plant Dis. Reptr. 36: 247-252. 1952. (Available on request)
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Table 1. Progress of sweetgum blight

Location	Trees In plot	Healthy		Diseased only							
				Class 1		Class 2		Class 3		Dead	
		1952[a]	1953	1952[a]	1953	1952[a]	1953	1952[a]	1953	1952[a]	1953
	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
Stoneville, Miss.	50	50	41	0	6	0	2	0	0	0	1
	50	50	43	0	6	0	1	0	0	0	0
	50	14	0	29	26	5	18	1	5	1	1
	50	37	26	10	17	1	3	2	2	0	2
	50	37	31	7	10	2	4	3	2	1	2
	24	14	14	6	1	4	8	0	0	0	0
	40	11	1	14	10	7	8	7	3	1	18
	50	48	32	0	10	1	1	1	3	0	4
Vance, Miss.	50	45	44	5	6	0	0	0	0	0	0
Oxford, Miss.	50	20	19	15	18	11	9	3	3	1	1
	50	27	25	22	24	0	0	1	0	0	1
	50	29	17	16	23	4	5	1	5	0	0
	50	36	29	11	15	2	4	1	1	0	1
Glendale, Md.	40	30	25	1	3	2	3	6	5	1	4
Beltsville, Md.	52	33	24	5	10	8	5	6	6	0	7
Chase City, Va.	84	60	42	6	22	4	4	11	2	3	14
N. Augusta, N.C.	46	31	17	0	9	0	4	3	2	12	14
Chilesburg, Va.	78	21	22	25	18	12	11	6	11	14	16
Beltsville, Md.	47	32	27	9	10	4	6	0	2	2	2
Savage, Md.	81	44	35	25	24	6	11	4	5	2	6
National Arboretum	15	3	1	6	3	5	6	1	5	0	0
Greenbelt, Md.	187	71	39	74	54	38	60	4	15	0	19
University Park-College Park, Md.	614	319	152	150	157	115	132	29	109	1	64
Totals	1858	1062	706	436	482	231	304	90	186	39	177

[a] Plots at Oxford, Miss., were established in May 1953, and reexamined in September 1953.

has taken place (Table 1). Over one-third of the trees on several plots died within one year, and some trees got worse on all plots. With rare exceptions trees showed no improvement during this time.

Possible Causes

With a disease like the sweetgum blight, weather, soil and water relations, stand condition, fungi, insects, and virus, all must be considered as possible causes. Moreover, the symptoms could be produced by a number of different and perhaps unrelated factors.

Physiological factors. -- Although the blight's wide distribution on all types of soils makes it seem unlikely that a lack or excess of any nutrient could be the cause, some small-scale fertility tests have been undertaken. After one year they give no indication that fertilizer can check or minimize the disease.

On the very best sweetgum sites trees are not affected, as a rule, until they are nearly mature. Apart from this observation, no data are available as yet on the effect of site and site factors.

Fungi. -- Pathologists have made hundreds of isolations and inoculations in their attempts to reproduce this disease. Insufficient time has elapsed for a proper evaluation of this work, but to date no organism has been isolated that seems likely to be the cause of the disease.

Virus. -- Since there is a possibility that the blight may be caused by a virus, bark patch grafting experiments were started in 1952. Again sufficient time has not elapsed, but so far there is no indication that the disease can be transmitted by grafting.

Summary and Conclusions

Sweetgum blight has increased rapidly in recent years, and appreciable mortality may accompany the disease. A number of possible causes are being investigated, but so far no factor has even been eliminated as possibly contributing to the disease. Further work is urgently needed to determine the cause.

Until more is known, forest managers must be advised to salvage merchantable trees as soon as they become blight-infected. Mortality may be rapid and recovery is not to be expected. Owners of shade trees can only be advised to replace dying sweetgums with some other species.

FOREST SERVICE AND AGRICULTURAL RESEARCH SERVICE

ADDITIONAL INFORMATION ON THE SURFACE STERILIZATION OF POPLAR CUTTINGS

Alma M. Waterman and Kenneth F. Aldrich

In 1952 experiments were conducted on the surface sterilization of poplar cuttings to prevent the transmittal of fungus diseases by spores that might be imbedded in the resinous coating of uninfected buds or lying free in the lenticels. The results[1] indicated that a 5% solution of mercuric chloride in 70% alcohol, in which the cuttings were dipped four seconds or longer and not rinsed, effectively prevented the germination of spores on buds and in lenticels. Clorox, Bordeaux mixture, and mercuric chloride in a 0.1% solution in 70% alcohol proved unsatisfactory.

In cuttings dipped four seconds in the 5% mercuric chloride-alcohol solution and stored two weeks before planting, the residual mercury caused a blackening of the tissue at the ends of the cuttings, extending 2 to 5 mm. If this tissue was removed by cutting 1/2 inch from each end before planting, no further phytotoxic effect occurred. Later tests showed that this blackening of the tissue progressed slowly on some of the clones during storage if cuttings dipped four seconds were stored longer than two weeks, or if they had been dipped two or five minutes. Black spots around lenticels or bark wounds indicated that the mercuric chloride had penetrated these areas. Such cuttings showed a slight injury from the mercury when planted in the greenhouse after four weeks of storage. A very few of the cuttings died. Others showed considerable dieback, but normal shoots developed from buds below the injured area. Root development was slightly retarded on all affected cuttings. It is evident, therefore, that in using the 5% mercuric chloride-alcohol solution without rinsing, certain precautions must be taken to prevent injury. The cuttings must not be dipped longer than four seconds; 1/2 inch must be cut from each end before planting; the storage period after dipping must not be longer than two weeks, and preferably the cuttings should be planted within a week after dipping. In the present study, however, the method of treatment with mercuric chloride was revised in an attempt to reduce or eliminate phytotoxicity.

During the dormant season, January through March 1953, additional experiments were undertaken with selected organic and inorganic fungicides to determine whether other chemicals would prevent the germination of fungus spores on buds or in lenticels, and thus give a percentage of sterility equal to that obtained from dipping in the 5% mercuric chloride-alcohol solution, without injury to or the retarding of growth of the cuttings.

Method and Materials

Healthy dormant cuttings were obtained on January 5 from stems of five hybrid poplar clones in a planting at Cheshire, Connecticut, and on January 5 and February 4 from 11 hybrid poplar clones in the U. S. Forest Service planting at Beltsville, Maryland. The selected clones represented several parentage crosses and had shown varying degrees of susceptibility to infection by the canker-producing fungi, Septoria musiva and Dothichiza populea, and by the leaf blotch fungus Septotinia populiperda. The cuttings from the Cheshire plot were made from the past season's growth on stems of three-year-old trees and were used in a preliminary series of tests to determine particularly the effect of the chemicals on the fungus spores. Treatments that seemed to have some effect on the spores were then used for the tests with the larger number of clones from the Beltsville planting. These latter were of good quality, such as might be distributed for establishing new plantings.

In preparation for each treatment, two cuttings of each clone were sprayed thoroughly with a water suspension containing a mixture of viable conidia of the above species of Septoria, Dothichiza, and Septotinia. The cuttings were partially dried at room temperature, wrapped in waxed paper, and left at room temperature over night. The wrapped cuttings were then stored in a refrigerator at 40° F. until they were to be dipped in the chemicals. Conidia of the three fungi germinate readily over-night at room temperature and both germinated and nongerminated conidia remain viable under refrigeration at 40°. Therefore, this method provides a distribution of germinated, as well as nongerminated, viable conidia of known fungi on the buds and in the lenticels, and supplements any natural distribution of conidia on the trees from which the cuttings were made.

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[1] Waterman, A. M. and K. F. Aldrich. Surface sterilization of poplar cuttings. Plant Dis. Reptr. 36: 203-207. 1952.

After the cuttings were dipped in the chemicals, they were partially dried, again wrapped, and stored for varying periods of one to four weeks. Cultures were then made by selecting at random from the two cuttings of each clone four buds, which were removed from the stems by sterile forceps and deposited on a layer of malt agar in petri dishes. Similarly, from the same cuttings, four lenticels with a small amount of surrounding bark were carefully cut from the stems and cultured in petri dishes. Control cultures also were made of buds and lenticels from cuttings sprayed with the spore suspension, but not dipped in the test chemicals.

Three cuttings of each clone were not sprayed with the conidia, but were dipped in each of the test chemicals, wrapped, and stored in the refrigerator for varying periods, then planted in sand in the greenhouse. One-half inch was cut from each end of the cuttings before they were planted. Control tests were made by planting a similar number of untreated cuttings of each clone. In most of the tests, the cuttings were dipped individually four seconds in the chemicals. When dipped for longer periods, the cuttings of each clone were tied together in a loose bundle and all were placed in the test chemical, which, in the case of a suspension, was agitated frequently. Details concerning length of dip and storage period following treatment are given in Table 1.

The cuttings were not rinsed in water immediately after they were dipped in the chemicals. However, in two series of treatments with mercuric chloride, the cuttings were stored two weeks after dipping, then rinsed thoroughly in running water, and again stored. This process would indicate whether rinsing would tend to decrease the toxic effect of the residual mercury during storage. One series was planted in the greenhouse after a further storage period of two weeks, a total of four weeks' storage after dipping. The other series, on the day after rinsing, was shipped to the U. S. Forest Service, Beltsville, Maryland, where the cuttings were planted in a nursery plot soon after they were received, approximately three weeks after dipping.

The chemicals tested[2] and the concentrations used were as follows:

Ferbam (ferric dimethyl dithiocarbamate) 1% in water.
Dithane Z78 (zinc ethylene bis dithiocarbamate) 1% in water, 2% in water with 1% Tergitol.
Captan, formerly SR406 (N-trichloromethyl thiotetrahydrophthalamide) 1% in water, 2% in water.
CRAG 341 (2-heptadecyl glyoxalidine acetate -- formulation 2 lbs. active chemical/gallon) 1% in water.
CRAG 531 (calcium-zinc-copper-cadmium chromates) 1% in water.
CRAG 5400, experimental fungicide (N-dimethyl thioformamide) 1% in water.
Dowicide G (sodium pentachlorophenate) 0.5% in water, 1% in water.
Dow formulation M137 (90% dehydroacetic acid) 1%, 3%, 5%, in 70% ethyl alcohol.
Dow formulation M138 (90% dehydroacetic acid, sodium salt) 1%, 3%, 5%, in water.
Ceresan M (7.7% ethyl mercury p-toluene sulfananilide) 2%, 3%, in water.
Semesan (30% hydroxymercurichlorophenol) 1% in water.
Mercuric chloride, 5% in 70% ethyl alcohol.

Results of Experiments

Effect of treatments on growth of fungi from buds and lenticels: Six chemicals did not prevent the development of the fungus spores on buds or in lenticels, when used in the following concentrations with storage periods of one to three weeks after treatment: -- ferbam, 1% in water, stored 1 week; Dithane Z78, 1% and 2% in water, stored 1 week, 2% stored 3 weeks; captan, 1% and 2% in water, stored 1 week, 2% stored 3 weeks; CRAG 341, 1% in water, stored 1 week; CRAG 531, 1% in water, stored 1 week; Dowicide G, 0.5% and 1% in water, stored 1 week, 1% stored 3 weeks. In all these treatments, the cuttings were dipped individually four seconds. Isolations of the parasitic fungi, particularly the Septotinia, were frequent, and therefore the chemicals were not used in additional tests.

The six remaining chemicals decreased or prevented the development of spores of the par-

[2] Test samples of the chemicals were supplied as follows: - ferbam, Dithane Z78, and captan from stock supplies at the Connecticut Agricultural Experiment Station, New Haven; CRAG formulations by the Carbide and Carbon Chemicals Company; Dow formulations by Dow Chemical Company; Ceresan M and Semesan by E. I. DuPont de Nemours and Company, Semesan Laboratory.

Table 1. Effect of fungicides on development of fungus spores from buds and lenticels of dormant poplar cuttings.

Treatment	Storage period after treating weeks	Buds		Lenticels		Effect on spores of parasitic fungi[b]
		Cultured Number	Sterile[a] Percent	Cultured Number	Sterile[a] Percent	
NO TREATMENT		44	0	44	0	
CRAG 5400						
4-second dip						
1% in water	1	20	0	20	0	Poor
5-minute dip						
1% in water	1	20	0	20	0	Poor
1% in water	3	24	0	24	17	Poor
15-minute dip						
1% in water	2	20	5	20	40	Poor
1% in water	4	24	0	24	4	Poor
DOW M138						
4-second dip						
1% in water	1	20	0	20	10	Poor
3% in water	1	20	0	20	15	Poor
3% in water	3	24	12	24	70	Poor
5% in water	2	20	0	20	65	Poor
5% in water	4	24	4	24	33	Poor
DOW M137						
4-second dip						
1% in 70% alcohol	1	19	0	20	0	Poor
3% in 70% alcohol	1	20	0	20	45	Poor
3% in 70% alcohol	3	24	0	24	62	Poor
5% in 70% alcohol	2	20	5	20	90	Poor
5% in 70% alcohol	4	24	8	24	100	Poor
SEMESAN						
15-minute dip						
1% in water	1	20	33	20	95	Good
1% in water	3	24	62	24	100	Excellent
1% in water	3[c]	44	48	44	98	Excellent
30-minute dip						
1% in water	1	19	58	20	100	Excellent
CERESAN M						
4-second dip						
2% in water[d]	1	20	50	20	95	Excellent
2% in water[d]	3	24	67	24	100	Excellent
2% in water[d]	3[c]	44	70	44	100	Excellent
2% in water	2	20	95	20	100	Excellent
2% in water	4	24	75	24	100	Excellent
3% in water[d]	1	20	100	20	100	Excellent
MERCURIC CHLORIDE						
4-second dip						
5% in 70% alcohol	3[ce]	44	68	44	98	Excellent
5% in 70% alcohol	4[e]	44	68	44	100	Excellent
5% in 70% alcohol	3[c]	44	77	44	100	Excellent

[a] "Sterile" indicates no isolations of parasitic or saprophytic fungi.

[b] "Poor" indicates more than 2 isolations of parasitic fungi; "good" indicates 1 or 2 isolations; "excellent" no isolations.

[c] One hundred ten cuttings in each of these series were planted in a nursery plot to test effect of treatment on survival and growth of cuttings.

[d] After treatment, these cuttings were exposed to the air 5 hours before being wrapped for storage, to prevent possible phytotoxicity.

[e] After 2 weeks storage following treatments, these cuttings were rinsed thoroughly in running water, and again stored.

asitic fungi and also of the saprophytic fungi. The results from the tests with these chemicals are given in Table 1. The complete sterilization of lenticels was obtained much more readily than that of the resinous buds. A few of the treatments with the formulations CRAG 5400, Dow M138, and Dow M137 were effective in sterilizing the lenticels but had little or no effect on the buds. It is possible that longer periods of treatment or higher concentrations might have resulted in a higher percentage of sterility. Isolations of Septoria from lenticels and Septotinia from buds were sufficiently frequent to indicate that these chemicals would not be satisfactory for control of the fungi, at the concentrations used in this study. No isolations of Dothichiza populea were obtained from the buds and lenticels in these treatments. Saprophytic fungi were abundant.

The treatments with Semesan, Ceresan M, and mercuric chloride were very effective in sterilizing the lenticels, and also in preventing the development of spores of the parasitic fungi that were lodged in the resinous coating of the buds. The percentage of sterility of buds, given in Table 1, indicates the difficulty in obtaining complete sterilization. From the nonsterile buds, a fungus resembling Pullularia pullulans, which has been reported frequently as occurring on buds of various plants, was commonly isolated. It produced a slow-growing suppressed hyaline mycelium, with hyaline ovoid or elliptic spores budding from the fertile hyphae, giving the colony a moist waxy appearance. In some isolates after two weeks of growth, both hyaline and brown spores were produced and numerous radiating filaments or strands of hyaline or brown vegetative hyphae were formed. Other isolates were composed almost entirely of vegetative hyphae. This fungus has been consistently isolated from the buds of all poplar clones used in this study and is almost entirely responsible for the seemingly low percentage of sterility in the buds treated with Semesan, Ceresan M, and mercuric chloride. Usually the percentage of sterility was determined two weeks after the cultures were made. In many cases, buds at that time would appear to be sterile, but in one or two weeks thereafter colonies of this fungus would develop. It was not isolated from lenticels in the treatments with these chemicals and occurred very rarely from the lenticels treated with the other chemicals. It probably is common on the bud scales and has no significance so far as disease is concerned. Semesan and Ceresan M are therefore considered to be excellent in the prevention of the transmittal of spores of parasitic fungi. Semesan in a concentration of 1% in which the cuttings are dipped for 15 to 30 minutes, or Ceresan M in a 2% concentration and 4-second dip gave a high percentage of sterility.

Effect of treatments on growth of cuttings: No serious phytotoxic effect was evident on any of the treated cuttings planted in the greenhouse. Those dipped in the 5% mercuric chloride-alcohol solution and stored two weeks showed a pronounced blackening of the cambium at the ends, usually extending 5 to 10 mm. along the stem. Cuttings rinsed in running water at that time showed no further development of the discoloration. When planted in the greenhouse two weeks later, 1/2 inch was cut from each end, thus removing the affected areas. The growth of these cuttings was slightly retarded in comparison with that of the untreated cuttings planted as checks. Healthy shoots and roots were formed but even after two months the difference in growth rate was evident.

Cuttings of some of the clones treated with Semesan or Ceresan M were very slightly blackened at the ends, never for more than 4 mm. and scarcely distinguishable from the drying at the ends of untreated cuttings. There was no further increase of the discoloration during storage. When planted in the greenhouse, 1/2 inch was cut from each end. Since the clones selected for treatment represented several combinations of parent species, the rapidity of development of roots and shoots varied according to clonal characteristics. The ultimate development of the treated cuttings of each clone during two months of growth in the greenhouse equalled that of the corresponding untreated cuttings.

The cuttings dipped in Ceresan M and wrapped immediately after dipping produced roots and shoots comparable in growth with those of the cuttings that were aired for five hours after dipping. These results indicate, therefore, that treatments with Semesan or Ceresan M may be more satisfactory than those with the 5% mercuric chloride-alcohol solution. The results of the survival and growth tests of the cuttings treated with these three chemicals, and planted in a nursery plot at Beltsville, Maryland, will be reported elsewhere[3].

These preliminary tests have shown that Semesan and Ceresan M are effective sterilizing

[3] Ford, H. F., and A. M. Waterman. 1954. Effect of surface sterilization on survival and growth of field-planted hybrid poplar cuttings in the field. Plant Dis. Reptr. 38: 101-105

agents for poplar cuttings, and are nontoxic to cuttings that have been stored for a short period before planting in the greenhouse. More extensive experiments are needed to develop a practical method by which a large number of cuttings can be dipped economically, in both materials and time, and to determine the reaction of treated cuttings when grown under natural field conditions. Such experiments may be of interest to tree breeders who wish to distribute cuttings for new plantings in this country or for experimental breeding in foreign countries.

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EFFECT OF SURFACE STERILIZATION ON SURVIVAL AND GROWTH OF FIELD-PLANTED HYBRID POPLAR CUTTINGS

Harold F. Ford and Alma M. Waterman

Selection of optimum sterilization agents, to prevent transmittal of fungus diseases by spores, depends both on laboratory tests for their effectiveness, and on field plantings to determine any possible latent phytotoxicity. The results of laboratory tests[1,2] indicate that two chemicals, Semesan and Ceresan M, were effective sterilizing agents for hybrid poplar cuttings. When cuttings treated with these chemicals were tested in the field, no harmful effects resulted from Semesan treatment, but mortality was greater and growth less in cuttings treated with Ceresan M. Clonal differences were also evident in some cases. The field aspects of this surface sterilization work are presented here.

METHODS OF EXPERIMENTATION

In the past some hybrid poplar cuttings have been shipped to widely different localities without recourse to sterilization. In that way it was possible that fungus diseases of poplar could have been spread to new localities. Because of this danger, experiments were initiated to test a number of fungicidal treatments on cuttings. One of the criteria for a suitable treatment was non-phytotoxicity to the planting material. The final test of any possible phytotoxic effect was provided by observations following usual field planting procedures.

Field Procedures

Dormant hybrid poplar cuttings were collected from nursery stock February 4, 1953, and shipped to the Forest Disease Investigations Laboratory in New Haven, Connecticut, on February 9. After being treated and stored, the cuttings were returned on April 3 to the Beltsville Experimental Forest, Laurel, Maryland, where they were stored in a cold room at approximately 30° F. When collected, all cuttings were graded to the standard size group of 3/16 to 1/2 inch in diameter, and cut to a length of 12 inches.

On April 7 cuttings were removed from storage and planted at the Experimental Forest nursery. Cuttings were spaced approximately 1 foot apart in rows 3 feet apart. Planting was done by use of the regular planting bar used for poplar cuttings. An attempt was made to plant cuttings at a depth that would allow two buds of each cutting to extend above the surface. As a result of knowledge gained in the greenhouse tests, blackened ends were cut from cuttings before planting. The average amount cut off was approximately one-half inch. Bud scales of one clone (OP-52) had begun to slip; other clones apparently were dormant. During the growing season usual procedures of weeding, cultivating, and watering were followed.

Field Design

The cuttings were planted in five rows, with all cuttings given a single treatment assigned to a row at random. The placement of clones in each row was also at random. This resulted in a simple experimental design, with the treatment x clone interaction serving to test treatment variation.

Summary of Treatments

A description of the chemical treatments given cuttings at the New Haven Laboratory follows:

Ten cuttings of each of the following clones were used in each treatment: OP-8, -10, -28, -45, -52, -201, -221, -232, -283, -302, -313.

1) - 5% mercuric choride solution in 70% alcohol. March 16: Cuttings dipped

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[1] Waterman, A. M., and K. F. Aldrich. 1952. Surface sterilization of poplar cuttings. Plant Dis. Reptr. 36: 203-207.

[2] _____, and _____. 1954. Additional information on the surface sterilization of poplar cuttings. Plant Dis. Reptr. 38: 96-100.

4 seconds, rinsed, wrapped in waxed paper, stored at 40° F.

2) - 5% mercuric chloride solution in 70% alcohol. March 16: Cuttings dipped 4 seconds, not rinsed, wrapped in waxed paper, stored at 40° F. March 30: Cuttings rinsed 15 minutes in running water, wrapped and stored.
3) - Ceresan M, 2% suspension in water. March 16: Cuttings dipped 4 seconds, not rinsed. Left exposed to air (room temperature) 5 hours, wrapped in waxed paper, stored at 40° F.
4) - Semesan, 1% suspension in water. March 16: Cuttings soaked 20 minutes, wrapped in waxed paper, stored at 40° F.
5) - Untreated controls. Cuttings from the same clones shipped to New Haven were reserved in storage.

Observations and Measurements

The first recorded observations and measurements were made the end of May. Considerable mortality was seen then in the groups that had been treated with 5% mercuric chloride treatment, either with or without rinsing. During the growing season cuttings were inspected for any incidence of disease. No sign of Septotinia populiperda was discernible; no leaf blotch was observed.

Final measurements and observations were made in October. The height of the cuttings was measured to the nearest one-half inch, and data on survival were taken.

Analysis of Data

Significance comparisons were obtained by analysis of variance. The "t" test was used for individual comparisons. Analyses were made on two groupings of the data. In one of these, clones number 232 and 313 were omitted because, with no surviving cuttings with nonrinsed mercuric chloride treatment, comparisons of survival were obvious. In the other treatments, survival and growth with these clones were also the poorest, even in the controls. The second grouping was made to point up comparisons with treatments other than those treated with mercuric chloride and not rinsed. General conclusions from this grouping were indentical with those from the first group. The basic data used for these computations were survival and total average height growth.

RESULTS AND DISCUSSION

In general, the results of this field study substantiate those reported in the preceding paper by Waterman and Aldrich based on the laboratory and greenhouse portion of this experiment. However, the results go one step further, and simulate in part what would happen in practice, were cuttings to be stored and shipped after treatment, and then planted in the field. This additional handling provides a more severe test of the phytotoxicity of the treatments. In addition, somewhat unexpected growth reactions due to treatment showed up.

The summarized results appear in Table 1. The number of surviving cuttings are those left at the end of the season out of 10 originally planted. The height data is the average for all surviving cuttings in each group.

Effect of Treatment on Survival and Growth

There were significant differences in the average survival of hybrid poplar cuttings receiving the various treatments. Treatment averages are given in Table 2.

The most important aspect of the results is the relative phytotoxic effect of the various treatments on survival. It is obvious that nonrinsed cuttings treated with mercuric chloride showed poorest survival. The next most toxic treatment was mercuric chloride with rinsing. Rinsing cuttings lessened the phytotoxic effect, but was not such a good sterilizing treatment according to Waterman and Aldrich[2]. Yet over 50% of the cuttings died.

Semesan proved to have no discernible phytotoxic effect. With this treatment, survival was just as good as in the untreated controls. When treated with Ceresan M an average of 24% of cuttings died in the field tests.

These field results with Semesan and Ceresan M differ from those obtained in the greenhouse trials. Under greenhouse conditions there was no great difference in the phytotoxic effect of the two chemicals. Since, in practice, sterilized cuttings will be stored and/or

Table 1. Average survival and height growth of hybrid poplar cuttings treated with various chemicals and grown in the field.

Clone number	Treatment: $HgCl_2$ Not rinsed	$HgCl_2$ Rinsed	Ceresan M Not rinsed	Semesan Not rinsed	Untreated controls
	Average height growth in inches				
OP- 8	17.2	32.5	29.9	37.2	31.4
10	8.7	32.8	30.7	26.3	23.1
28	12.0	62.0	21.9	75.4	58.6
45	9.1	22.8	44.9	44.2	62.8
52	56.0	38.3	18.1	42.4	17.8
201	25.7	31.8	22.6	88.2	42.6
221	14.2	44.2	24.2	43.6	29.0
232	-	17.2	15.0	23.1	25.4
283	36.2	41.9	22.5	43.2	23.0
302	12.9	70.0	22.2	42.2	33.2
313	-	22.0	55.6	48.8	31.0
	Average number surviving				
OP- 8	3	2	9	10	10
10	3	6	9	9	10
28	3	5	6	10	10
45	7	6	8	10	10
52	1	3	9	9	10
201	3	3	4	10	10
221	2	2	6	7	9
232	0	3	3	6	8
283	4	5	9	10	10
302	8	9	8	10	10
313	0	1	5	7	9

shipped, and greenhouse facilities will not always be available at the receiving point, these field trials would seem to be a more significant indication of the relative phytotoxicity of the various treatments for practical conditions.

Comparative results of the various treatments on the average height growth of the clones tested are also given in Table 2.

When the cuttings were planted in the field, treatment with mercuric chloride (not rinsed) and Ceresan M resulted in significantly less growth than when treated with mercuric chloride (rinsed) and Semesan. However, neither of these two groups was significantly different from the controls in height growth averages for all clones. Thus, when compared to the controls, none of the treatments significantly retarded or stimulated growth. However, the most effective sterilizing treatments, Semesan and Ceresan M, differed significantly in their effect on the average height growth of the cuttings. The greatest average height growth of 49.2 inches occurred in cuttings treated with Semesan. The poorest average height growth of 26.3 inches occurred in cuttings treated with Ceresan M. This fact, and better survival, seems to indicate the practical superiority of Semesan over Ceresan M as a sterilizing agent when cuttings are planted in the field.

Table 2. Effect of fungicidal treatment on the average survival and height growth of cuttings grown in the field for one season[a].

Treatment Number	Treatment Method	Average survival	Height growth
		Percent	Inches
XXI	$HgCl_2$ (not rinsed)	38	21.3
XXII	$HgCl_2$ (rinsed)	46	41.8
XXIII	Ceresan M (not rinsed)	76	26.3
XIV	Semesan (not rinsed)	94	49.2
XV	Untreated controls	99	35.7

[a] Fiducial limits for comparison of treatment means:
Survival data - 1% level = 18.4; 5% level = 13.7.
Growth data - 1% level = 20.1; 5% level = 15.0.
Clones OP-232 and OP-313 were not included in this analysis.)

Variations in Clonal Response

Some clones showed significantly better survival than others, when considered from averages for all treatments. Clones 232 and 313 were consistently at a low relative level for all treatments, with none surviving after treatment with mercuric chloride and not rinsed. It would seem that these two clones, even with uniform graded cuttings, were less able to withstand the mildest sterilization method used, than were the cuttings of the other clones. For analysis purposes these two clones were omitted. Results for the remaining nine clones are given in Table 3.

The poorest average survival among these nine occurred in clone 221. From a treatment standpoint this clone showed equivalent survival when treated with either Ceresan M or Semesan. In contrast clone 201, with the next poorest average survival, only had 40 percent of the trees living in the group treated with Ceresan M, while 100 percent survived with Semesan treatment.

Other significant clonal differences in survival may be derived from the fiducial limits appearing as a footnote in Table 3. Clone 302 exhibited the best average survival, even showing up well with the most severe treatments. Clone 45, a fast grower and consistently good in other experiments, also survived well.

There were no significant differences in the average height growth of the clones for all treatments. In other words, none of the clones consistently made greater or less growth than others for all treatments during the season in field plantings. Within treatments there may have been clonal differences in height growth, but this experiment was not designed to make such precise comparisons possible.

General

These results definitely eliminate mercuric chloride treatment, either with or without rinsing, as a practical means of sterilizing these hybrid poplar cuttings, because of the poor survival of such cuttings in field plantings. Although the greenhouse tests revealed no serious phytotoxic effect with mercuric chloride treatment, the growth of these cuttings was slightly retarded in comparison with that of untreated cuttings planted as checks. However, subsequent shipment and storage appeared to have a further detrimental effect on the cuttings receiving mercury treatments.

It is reasonable to assume that under many practical situations sterilized cuttings will be in storage plus in transit for periods exceeding two weeks, and shipment cannot often be made under ideal conditions of low temperatures and moisture. Also, greenhouse conditions will not always prevail at the receiving end, and cuttings will have to be planted in the field. Under these circumstances treatments other than with mercuric chloride would seem to be better, as brought out in these experiments.

Table 3. Effect of fungicidal treatment of cuttings on the average survival and height growth of different hybrid poplar clones grown in field plantings[a].

Clone (Populus hybrid) Number	Parentage	Average survival	Height growth
OP- 8	P. nigra x P. laurifolia	68	29.6
10	P. nigra x P. trichocarpa	74	24.3
28	P. charkowiensis x P. trichocarpa	68	46.0
45	P. maximowiczii x P. berolinensis	82	36.8
52	P. maximowiczii x P. nigra plantierensis	64	34.5
201	P. deltoides virginiana x P. trichocarpa	60	42.2
221	P. deltoides virginiana x P. caudina	52	31.0
283	P. nigra x P. laurifolia	76	33.4
302	P. nigra betulifolia x P. trichocarpa	90	36.1

[a] Fiducial limits for comparison of clonal means:
Survival data - 1% level = 25.0; 5% level = 18.5.
Growth rate - no significant differences at 5% level.
(The following clones were not included in this analysis:
OP-232 P. deltoides virginiana x P. berolinensis
OP-313 P. charkowiensis x P. caudina)

Previously in this paper it was pointed out that Semesan appears to be a better sterilizing agent for cuttings than Ceresan M, from the practical standpoint of shipment and field plantings, on two important counts -- phytotoxicity and growth. Ceresan M treatments resulted in 24 percent mortality, while Semesan-treated cuttings grew nearly twice as tall as those treated with Ceresan M. Thus, it appears that from the practical standpoint of use, Semesan treatment of hybrid poplar cuttings has no detrimental effect, and could be effectively used for this purpose.

RECOMMENDED TREATMENT

It has been shown that Semesan is an effective sterilizing agent for hybrid poplar cuttings, from the standpoint of protection from Septoria musiva, Dothichiza populea, and Septotinia populiperda. Greenhouse and field tests have revealed no phytotoxic effects of Semesan treatment. Thus, this chemical is recommended as a sterilizing agent for hybrid poplar cuttings.

Hybrid poplar cuttings should be completely immersed in a 1% water suspension of Semesan (30% hydroxymercurichlorophenol) for a period of 20 minutes. No rinsing is necessary prior to preparation for shipment.

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THE EFFECT OF WEATHERING PRIOR TO HARVEST ON CERTAIN PROPERTIES OF COTTON FIBER

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Abstract

Available published information on the effect of pre-harvest weathering on the properties of cotton fibers is briefly summarized and certain new information on the subject is presented. The property changes observed are in some cases microbial and in other cases largely or entirely non-microbial in origin. The report includes certain general background facts, a brief description of a condition which occurs at the time of boll opening designated by the term "microbial tight lock," and information on the effect of weathering on fiber in normally-opened bolls. The latter subject is concerned with changes in several properties, namely, in aqueous-extract pH, content of reducing substances, degree of swelling in alkali, absorption of the dye Chlorantine Fast Green, moisture regain, length, strength, and appearance of the fiber in ultra-violet light. A new method for determining the reducing-substance content of raw cotton is described.

The present paper is a report of progress in a continuing investigation directed toward determining what changes in properties of cotton fiber occur as a result of exposure of the fiber to the weather during and after the period of boll opening and prior to harvest. The need for information on this subject arises from the fact that almost all of the domestic cotton crop is exposed to the weather for a period of from one to several weeks before picking and that information on the influence of this exposure on the use-value of the fiber is still very limited. It is intended to review very briefly here such published information as is available on the subject and also to present certain new relevant data.

GENERAL BACKGROUND

It is widely recognized that cotton fabrics exposed to the weather may lose strength as a result of either microbial action or sunlight (6). This prior information has offered a natural starting point in investigating pre-harvest deterioration of the raw fiber. A few basic background facts in respect to the action of micro-organisms and of sunlight on cotton may be mentioned as a preliminary to a somewhat more detailed examination of the title subject.

When cotton fiber is exposed to humid weather prior to harvest, the micro-organisms which may be observed to grow upon it consist in large measure of fungi of the genera Alternaria, Cladosporium, Fusarium, Diplodia, and Colletotrichum, and of certain yeasts and bacteria (8). Of these micro-organisms, the fungi are all known from laboratory tests to be inherently capable of causing strength loss in cotton fiber (11). This capability is, in fact, found to be a property of a wide variety of fungi, many of which occur on cotton in humid storage and under other circumstances (11). The best information available to date indicates that bacteria and yeasts of the types commonly found growing on cotton fiber in the field are probably in the main incapable of causing strength loss (11, 16). The fact that an organism is inherently capable of weakening the fiber under favorable growth conditions in the laboratory (11) does not, of course, prove that the same organism would necessarily cause a practically significant fiber strength loss when growing on the fiber under field conditions nor that a field-exposed fiber with the fungus growing on it has necessarily lost more strength during exposure than a similar fiber exposed to weathering under conditions in which no fungus growth occurred. The fungus Cladosporium, when grown on cotton fiber in the laboratory, causes a darkening in color (10) similar in appearance to that which occurs with cotton humid-weathered in the field, and it is considered highly probable that the darkening in color that occurs in the field and that is so detrimental to the grade and selling price of the fiber is principally of microbial origin.

Sunlight exposure of cotton fabric not only causes loss in strength, but also brings about easily measurable increases in cuprammonium fluidity, the fluidity change usually being detectable before loss in strength. The destructive action of sunlight on cotton fabric is generally agreed to occur largely if not entirely in the ultra-violet wave lengths. No method has been found to prevent sunlight damage to cotton fabric other than to screen out the ultra-

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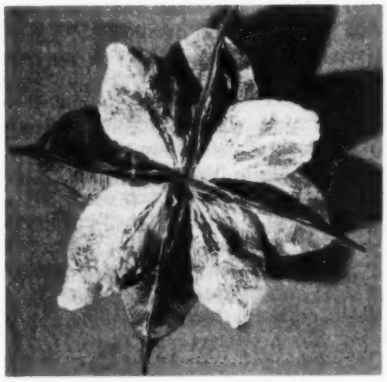
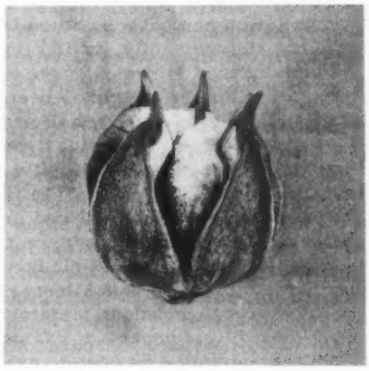
violet rays with inorganic pigments, a device which is obviously not adapted to use on raw cotton in the boll. Sunlight exposure also results in an alteration of the cotton fiber in some fashion which renders it less susceptible to subsequent rotting by micro-organisms (17).

MICROBIAL TIGHT LOCK

Wet weather occurring just at the time when cotton bolls are in the process of opening frequently results in a type of microbial attack on the fiber known as "microbial tight lock". The affected fiber fails to fluff out completely in the normal fashion and is usually darkened in color (Fig. 1). The condition has been described previously in respect to the causal organisms associated with it and the circumstances which favor its occurrence (12). While many of the bolls may be so severely affected that they do not open at all, or open very incompletely (Fig. 2), and the fiber consequently cannot be or is not picked, other less severely affected bolls do open sufficiently to allow picking and the affected fiber finds its way into commercial channels. The dark color of the locks is principally in certain structures of the micro-organism itself and may be removed mechanically during ginning. For this reason and because of the tendency for the dark color to be localized on the outside of the lock, the condition shown in Figure 1, which is very conspicuous when the fiber is on the plant, may be much more difficult to detect in ginned lint.





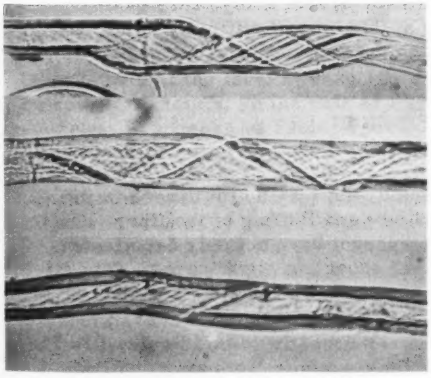


FIGURE 1. (top left). Cotton boll exposed to wet weather at the time of boll opening and exhibiting the condition known as "microbial tight lock". Fungus involved is Colletotrichum gossypii.

FIGURE 2. (top right). Cotton boll exposed to wet weather at the time of boll opening and exhibiting a severe degree of the condition described as "microbial tight lock". In still more severe instances, the fungus attacking this boll, Diplodia sp., entirely prevents opening of the boll and brings about a complete rotting of the boll and disintegration of the fiber.

FIGURE 3. (lower). Cotton fibers from bolls which were exposed to wet weather at the time of boll opening and exhibited the condition known as "microbial tight lock", as seen in Fig. 2. Note the typical helical splitting of the fibers. Photos by M. Jaeger.

Numerous samples of fiber from bolls affected with microbial tight lock have been examined microscopically. The fibers are found to exhibit several types of abnormal appearance, but the most constant and characteristic of these are 1) helical or diagonal splitting and rupture and 2) an uncollapsed condition, with few convolutions. Figure 3 shows manifestations of helical splitting, a condition apparently similar to the microbial-associated "splitting along the quick spiral" of Clegg (4). Blum and Stahl (3) state that a similar type of cleavage may be caused by the action of fungi on cotton in pure culture and by the action of cellulolytic filtrates from the fungus Myrothecium verrucaria. It should be stated that the helical splitting in fiber from microbial tight locks may be observed upon simply mounting the fiber in water. Both Clegg (4) and Blum and Stahl (3) employed alkali-swelling prior to their observations. The uncollapsed-fiber condition is at least superficially similar to the "doughnut fiber" condition described by Bailey (2) and may be identical with it. Bailey (2) associates "doughnut fibers" with serious spinning difficulties.

Microbial tight lock fiber exhibits unusually high swelling in alkali, as measured microscopically in terms of the alkali-swollen fiber width (18% NaOH) or by the alkali-centrifuge test and high percentages of red stained fibers in the well-known Congo Red test for fiber damage. Both length and strength of the fiber in microbial tight locks may be reduced, in some cases so markedly reduced as to be readily apparent when the fiber is handled and broken in the fingers.

Field observations on the incidence of microbial tight lock are still quite incomplete. However, the degree of leaf coverage around the bolls at the time of boll opening is obviously a very significant causal factor, in many cases of dominant importance. The "prevention of fiber deterioration" and "improvement in grade" which are associated with the practice of chemical defoliation are believed to be in large part a result of the prevention of microbial tight lock (12). Unfortunately, in addition to this type of microbial tight lock, there also occurs a drought-induced microbial tight lock for which no preventive measures seem to have been suggested. This difficulty has been noted by Arndt (1). It results when the bolls open prematurely in response to severe drought and become infected with micro-organisms.

In November 1953, a microbial tight lock sample differing in appearance from previously-observed samples was sent to Beltsville by Mr. Stuart Evans, the sample having been collected in the field at Blythe, California. The fiber was yellowish-brown in appearance and exhibited a brilliant yellowish glow when viewed in a darkened room under an ultra-violet light "Mineralight". With the exception of Fusarium tight locks, which are usually pinkish in color, most microbial tight locks are grey or black. Observation of tight locks caused by Diplodia, Fusarium, Colletotrichum, and Alternaria under ultra-violet light has to date revealed no strikingly fluorescent condition, a statement which is also true for fiber affected with the common bacterial blight organism, Xanthomonas malvacearum. Upon microscopic examination, the Blythe sample was seen to exhibit much helical splitting, accompanied by profuse fungal and bacterial growth. Several bacteria and fungi were isolated from the fiber, but the relative importance of each as causal factors has not yet been determined. The plants from which the sample was collected were large and leafy and the difficulty first became apparent at the time that the lower bolls began to open. A research worker with many years of field experience in California examined the sample and stated that this type of difficulty is not uncommonly encountered in California as a result of continuing the application of irrigation water too late in the season.

WEATHERING EFFECTS ON FIBER IN NORMALLY-OPENED BOLLS

Much cotton is not damaged during the boll-opening period, but may be influenced in its properties by weather exposure after normal opening of the boll and fluffing of the fiber. Only a few of the properties one might consider for study in this respect have actually been tested, and for these few properties the results are still of somewhat uncertain significance. Several interesting leads, however, have developed, the available results being summarized as follows.

Wax

It has been noted that the melting point of wax extracted from weathered cotton by a standard quantitative-analytical method is lower than is the case for wax from similar but unweathered fiber (7). (Actually, the property measured is a melting range, determined in a

standarized fashion.) While the wax on cotton fiber is widely believed to be of great importance in spinning and its removal renders the fiber unfit to spin, the influence of qualitative differences in normal wax composition on spinning performance seems not to have been reported upon by anyone to date. Wax melting point was found to be a relatively constant fiber character in tests on unweathered fiber samples from a widely diverse group of cotton varieties (7).

The concept of wax content of cotton is not an entirely settled one, in the sense that various solvents are used to extract the wax for its quantitative measurement and the amount of material obtained and measured depends on the type of solvent and the method of its use. When the hot ethyl alcohol-chloroform partition method is used, it is found that the "wax content" as measured by this test, increases somewhat during weathering (7). This result is considered to indicate simply that oxidation or other chemical reaction during weathering has rendered some material more soluble in the organic solvents used. Tests of wax content of fungus-incubated fiber have failed to indicate that this property is readily or greatly influenced by fungal action (10).

Aqueous-Extract pH

It has been observed that when cotton is weathered in a humid climate prior to picking, the pH of aqueous extracts of the fiber rises markedly. The phenomenon has been investigated in several of its aspects (13). A very similar rise in pH can be caused by micro-organisms acting on the fiber in the laboratory, and there seems to be little reason to doubt that the high pH values so frequently observed with humid-weathered raw cotton are actually a result of microbial action. Water-extracts of the fiber exhibit the same increase in pH when incubated with micro-organisms as do intact fiber samples, the material acted upon by the fungus in producing the pH change being presumed but not certainly known to be malic or other organic acid salts. The property, as determined on intact fiber, is extraordinarily responsive to microbial action, much more so than fiber strength or length (10), with the consequence that precautions need to be observed in the interpretation of the test results (13). Hall and Elting use aqueous-extract pH as a partial criterion for the identification of "cavitomic cotton" (5).

A recent observation of some practical interest concerns the fact that high-pH cotton kept under vacuum will not display the downward drift in pH reported earlier for samples stored with free access to laboratory air (13). Thus, fungus-incubated fiber of pH 9.5 maintained this pH unchanged for a year when stored in a vacuum desiccator. One possible application of this device would occur in a situation in which one wished to test the pH of a large series of samples without the complication of a downward-drifting pH during the period of several days or weeks which might be necessary to complete the tests. Another practical point concerns the fact that application of "Desicote" to the glass-electrode of the pH meter greatly speeds up the electrometric determination of pH by eliminating the prolonged rinsing of the glass electrode which is otherwise necessary between tests in order to obtain correct values.

Water-Soluble Reducing Constituents

When an open cotton boll is exposed to wet weather in the period before the fiber is picked, it is found that the level of reducing constituents in the fiber decreases. This result may be noted, for example, in the data of Figure 4, also in the data for Florence, South Carolina and Jackson, Tennessee in Table 1. It is known from previous evidence that micro-organisms acting in pure culture on the fiber in the laboratory have a similar effect and that the property is highly responsive to microbial action (10). Actual water-leaching of the fiber is thus apparently not necessary to produce the effects shown in Figure 4 and Table 1. The property measured is usually referred principally to the level of reducing sugars in the fiber.

The method used for the reducing substance tests of Figure 4 and Table 1 is a new one, devised particularly for application to raw cotton. It is a very simple and practical test referred to as the "copper-2" method and described in detail in the Appendix. The conditions of the test have been so selected as to make possible determinations over the total range commonly met with in raw cotton without alteration of the sample size or quantity of the various reagents.

An important source of variability in determinations of reducing-substance content of raw cotton is the wide difference between values obtained on fibers from the rounded (chalazal) end of the seed and those for fibers from the remainder of the seed. Thus, in one typical test chalazal fibers yielded a copper reduction value of 0.82 as contrasted with 0.37 for fibers from the rest of the seed. Such results indicate that ginned lint samples for reducing-substance

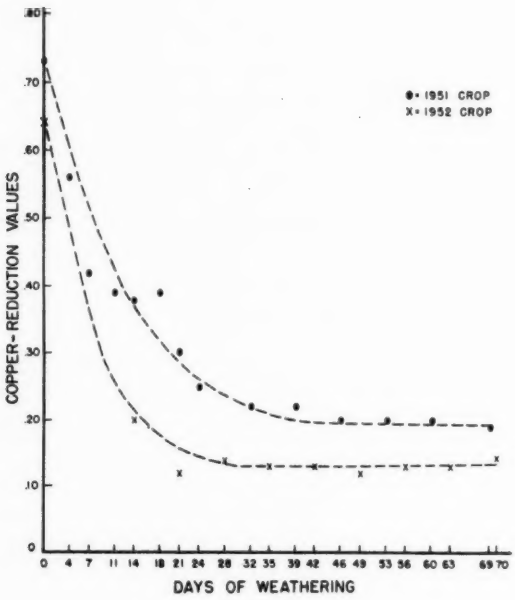


FIGURE 4. Effect of pre-harvest weathering at Florence, S. C. on the copper reduction values of cotton fiber, a property measured by a new method described in the Appendix.

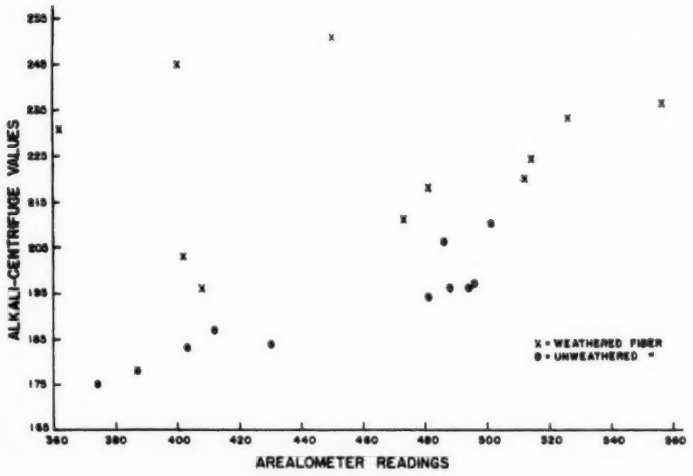


FIGURE 5. Alkali-centrifuge and arealometer values for a series of unweathered (0) and weathered (X) cotton samples.

Table 1. Effect of pre-harvest weathering at various locations in 1948 on several properties of cotton fiber. Columns of data from left to right in the order of discussion in text.

Sample: Location, variety, and period of weathering	Copper reduction values	Alkali-centrifuge values	Water-centrifuge values	Moisture regain At relative humidity 92% Raw fiber	92% Alkali-boiled fiber	65%	Strength, Stelometer, 1/8" jaw gap	Elongation, Stelometer	Arealometer
Shafter, Cal.									
Coker 100, None	.57	210	38.2	16.7	15.6	7.4	1.74	.41	501
Coker 100, 11 wks.	.53	236	34.9	16.4	15.4	7.1	1.53	.45	556
Deltapine 15, None	.41	206	38.2	17.0	15.6	6.8	1.68	.47	486
Deltapine 15, 11 wks.	.45	220	33.4	15.9	15.1	6.6	1.53	.44	512
Rowden 41 B, None	.45	187	35.9	16.8	15.1	7.4	1.62	.47	412
Rowden 41 B, 11 wks.	.45	196	30.9	15.8	15.1	6.9	1.45	.41	408
State College, N. M.									
Coker 100, None	1.29	194	37.4	17.7	15.2	7.4	1.63	.51	481
Coker 100, 12 wks.	1.11	218	29.2	15.6	15.2	7.0	1.46	.47	481
Deltapine 15, None	.99	196	38.1	17.4	15.4	7.2	1.66	.52	494
Deltapine 15, 12 wks.	.64	211	31.1	15.4	15.0	6.6	1.48	.48	473
Rowden 41 B, None	.85	178	35.7	16.8	15.4	6.8	1.58	.45	387
Rowden 41 B, 12 wks.	.41	203	29.2	14.6	15.0	6.4	1.42	.47	402
Florence, S. C.									
Coker 100, None	.92	183	32.5	16.2	15.1	7.1	1.69	.50	403
Coker 100, 11 wks.	.06	245	32.1	14.6	14.4	6.9	1.52	.42	400
Deltapine 15, None	.57	184	33.2	16.4	15.0	7.2	1.80	.53	430
Deltapine 15, 11 wks.	.14	251	33.7	14.0	14.9	6.7	1.57	.48	450
Rowden 41 B, None	.49	175	32.5	15.7	15.0	6.9	1.69	.46	374
Rowden 41 B, 11 wks.	.17	231	29.4	13.9	14.2	6.9	1.51	.43	362
Jackson, Tenn.									
Coker 100, None	.73	197	37.1	16.3	15.0	7.2	1.63	.43	496
Coker 100, 10 wks.	.29	224	34.5	14.9	15.0	6.9	1.55	.39	514
Deltapine 15, None	.71	196	37.7	16.8	15.2	7.6	1.75	.45	488
Deltapine 15, 10 wks.	.25	233	33.6	14.3	15.0	6.8	1.57	.43	526

tests need to be well mixed. In our own tests it has been customary to make up each test sample from at least 10 small tufts. Malic acid, a common natural constituent of the fiber, gives no reduction in the "copper-2" method.

Swelling in Alkali

It has been shown in a recent contribution that any of several deteriorative forces may lead to an increased degree of swelling of cotton fiber in alkali, and a convenient new method for measuring the property has been described under the designation "alkali-centrifuge test" (14). Weathering, apparently especially weathering in a humid climate, has been shown to cause moderate increases in this value, although even in a humid climate the property is much less responsive to change than either the aqueous-extract pH or the reducing content (14). In humid-atmosphere laboratory exposures to fungi in pure culture, the property is also only intermediate in responsiveness (10). Results of the alkali-centrifuge test may require simultaneous application of other types of test for unambiguous interpretation, for the reason that the alkali-centrifuge response reflects not only fiber damage, but also fiber wall thickness (14). It is considered that with unknown samples a high alkali centrifuge test result indicates

Table 2. Effect of prior alkali-boiling and of prior alkali-boiling and bleaching on the alkali-centrifuge values of weathered and unweathered cotton. Samples same as in Table 1.

Sample: Location, variety, and period of weathering	Alkali-centrifuge values with pre-treatments as follows:-		
	None	Alkali-boiled	Alkali-boiled and bleached
Shafter, Cal.			
Coker 100, None	210	243	259
Coker 100, 11 wks.	236	272	286
Deltapine 15, None	206	236	244
Deltapine 15, 11 wks.	220	253	264
Rowden 41 B, None	187	225	238
Rowden 41 B, 11 wks.	196	231	242
State College, N. M.			
Coker 100, None	194	240	255
Coker 100, 12 wks.	218	263	255
Deltapine 15, None	196	236	243
Deltapine 15, 12 wks.	211	254	269
Rowden 41 B, None	178	214	231
Rowden 41 B, 12 wks.	203	235	251
Florence, S. C.			
Coker 100, None	183	225	237
Coker 100, 11 wks.	245	282	302
Deltapine 15, None	184	213	228
Deltapine 15, 11 wks.	251	282	302
Rowden 41 B, None	175	216	226
Rowden 41 B, 11 wks.	231	258	274
Jackson, Tenn.			
Coker 100, None	197	234	245
Coker 100, 10 wks.	224	264	289
Deltapine 15, None	196	233	252
Deltapine 15, 10 wks.	233	278	287

fiber damage only when micronaire, arealometer, or other methods do not reflect the existence of a thin-walled condition. Either thin walls or fiber damage may lead to high alkali-centrifuge results. Figure 5, plotted from data in Table 1, illustrates the general phenomenon that weathered samples tend to have higher alkali-centrifuge values for a particular arealometer reading than do unweathered samples.

If paired unweathered-weathered samples are subjected to alkali-boiling or to alkali-boiling and bleaching prior to the alkali-centrifuge test, the results of the latter test show a general increase as a result of these pre-treatments, no clear trend toward accentuating or minimizing the differences between unweathered and weathered samples being apparent, Table 2. It was thought that the presence of oxycellulose in the weathered samples might cause them to increase more in alkali-centrifuge values during alkali boiling than the unweathered samples, but such did not turn out to be the case.

The microbial production of the enzyme which influences the alkali-swelling response ("S-Factor"), occurs only when the micro-organism is utilizing cellulose (9). This suggests a reason for the lower sensitivity of the alkali-swelling response in comparison with the pH and reducing substance responses, namely, that the latter occur as a result of the preferential utilization of non-cellulosic fiber constituents by the micro-organism (9, 10).

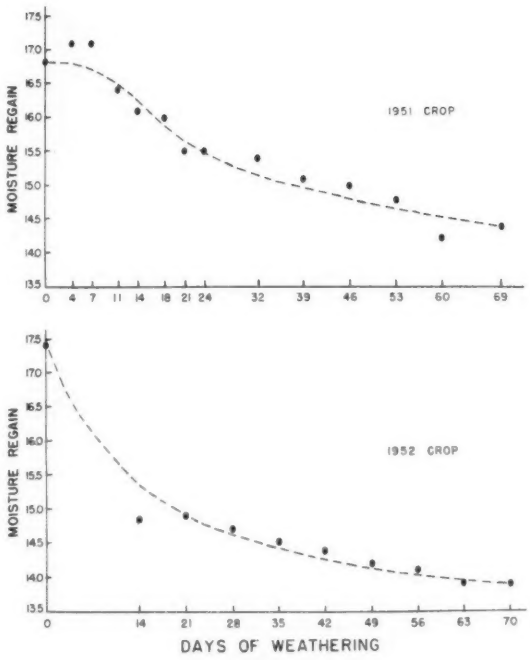


FIGURE 6. Effect of pre-harvest weathering of cotton fiber at Florence, S. C. on its moisture regain at 92% relative humidity and 70° F.

Moisture Regain

A previously-undescribed phenomenon has been noted in the fact that under certain test conditions here described, weathered cotton exhibits a lower moisture content than does similar but unweathered fiber. The first indication of this situation was provided by results of tests by a "water-centrifuge" technique. Since weathered cotton generally shows somewhat greater swelling in 18% NaOH and higher alkali-centrifuge values than similar but unweathered fiber (as may be seen in Table 1), it was wondered whether it would also show greater retention of water if tested by a weight-increase method similar to the alkali-centrifuge test (14) except using water rather than 18% NaOH as the swelling medium. It was found, on the contrary, that the "water-centrifuge" values for weathered cotton are actually lower rather than higher, Table 1. This finding led to the measurement of moisture content of the fiber in an atmosphere of known relative humidity, 92% R.H. at 70° F. being chosen and the samples allowed to equilibrate under these conditions for 7 days before drying over night at 105° to drive off the water. This property was also lower for weathered than for corresponding unweathered samples (Figure 6 and Table 1). Alkali-boiling prior to test largely eliminated the differences between the weathered and unweathered samples, Table 1. Tests on raw fiber at 65% R. H. and 20° C showed that moisture content for weathered fiber is lower than for unweathered fiber under these conditions also, although the absolute levels of moisture regain and the differences observed were both smaller than at the higher humidity (Table 1).

Absorption of the Direct Dye Chlorantine Fast Green

It has been found that when paired samples of unweathered and weathered raw cotton fiber are placed into a water solution of the direct dye Chlorantine Fast Green BLL, the amount of the dye removed by the fiber from the dye bath under the conditions used is lower for the weathered sample than for the unweathered (Table 3). If the samples are alkali-boiled (autoclaved at 15 lbs. steam pressure in 50 volumes of 1% NaOH for 5 hours) or alkali-boiled and bleached with hypochlorite at room temperature in 50 volumes of NaOCl of .1% available

Table 3. Effect of pre-harvest weathering of cotton fiber in 1948 on its absorption of the direct dye Chlorantine Fast Green. Fiber dyed for 1 hour at 80° C in 50 volumes of dye bath containing .02% dye, supplemented with .02% Na_2SO_4 in tests on alkali-swollen fiber and with .2% Na_2SO_4 in tests on non-alkali-swollen fiber. Samples same as in Tables 1 and 2.

Sample: Location, variety, and period of weathering	Dye content of fiber subjected to following treatments prior to dyeing:- None	Alkali-boiled	Alkali-boiled, bleached	Swollen in 18% NaOH	Alkali-boiled, swollen in 18% NaOH	Alkali-boiled, bleached, swollen in 18% NaOH
Shafter, Cal.						
Coker 100, None	.58	.70	.64	.65	.74	.74
Coker 100, 11 wks.	.48	.67	.62	.68	.72	.72
Deltapine 15, None	.57	.74	.69	.70	.74	.72
Deltapine 15, 11 wks.	.42	.64	.62	.62	.72	.67
Rowden 41 B, None	.53	.67	.65	.60	.72	.72
Rowden 41 B, 11 wks.	.40	.59	.59	.58	.67	.67
State College, N. M.						
Coker 100, None	.62	.69	.64	.62	.80	.74
Coker 100, 12 wks.	.36	.58	.60	.67	.75	.75
Deltapine 15, None	.65	.76	.67	.64	.82	.73
Deltapine 15, 12 wks.	.42	.59	.57	.64	.73	.71
Rowden 41 B, None	.50	.63	.59	.55	.74	.65
Rowden 41 B, 12 wks.	.35	.54	.51	.60	.72	.68
Florence, S. C.						
Coker 100, None	.45	.64	.62	.58	.72	.72
Coker 100, 11 wks.	.33	.57	.60	.71	.79	.75
Deltapine 15, None	.45	.67	.60	.60	.70	.66
Deltapine 15, 11 wks.	.32	.58	.58	.75	.78	.74
Rowden 41 B, None	.44	.64	.58	.57	.69	.66
Rowden 41 B, 11 wks.	.28	.51	.51	.71	.76	.68
Jackson, Tenn.						
Coker 100, None	.59	.71	.62	.64	.77	.73
Coker 100, 10 wks.	.42	.64	.65	.69	.76	.80
Deltapine 15, None	.58	.72	.70	.68	.75	.78
Deltapine 15, 10 wks.	.45	.72	.65	.73	.75	.80

chlorine for 1 hour) prior to dyeing, the weathered samples still absorb less dye than the unweathered, although the absolute amounts of dye absorption are increased for both unweathered and weathered fibers by these pretreatments (Table 3).

If raw cotton samples, unweathered and weathered, are swollen in 18% NaOH prior to dyeing, the weathered samples frequently but not invariably absorb more dye than the unweathered (Table 3). This result apparently occurs in consequence of the higher degree of swelling of certain of the weathered samples in the 18% NaOH. Of the samples listed in Table 3, only those from Florence, South Carolina exhibited a distinctly higher alkali-centrifuge value for the weathered than the corresponding unweathered fiber. If alkali boiling or alkali boiling and bleaching preceded the alkali swelling, the differences between unweathered and weathered samples tended to be minimized, Table 3. The higher dye absorption of weathered-mercerized as compared with unweathered-mercerized fiber is paralleled by the behavior of fiber incubated in a saturated atmosphere with Cladosporium. Thus, fiber incubated for periods of 0, 4, 7, 14, 21, and 28 days, swollen in 18% NaOH, and dyed, showed dye contents after one hour of .55, .56, .63, .71, .72, and .74 percent, respectively.

Table 4. Effect of weathering approximately 11 weeks in the field prior to harvest at Florence, S. C. and at Shafter, Cal. in 1948 on strength and length of cotton fiber. Total rainfall of 15.0 inches at Florence and of 0.34 inches at Shafter.

Sample	Varieties								Average change, all varieties
	Acala 1517	Acala 4-42	Coker 100	Coker Wilds	Deltapine	Mebane	Rowden	Stoneville 2B	
	Pressley strength: percent change during weathering								
	Zero-gap jaws, fast car speed								
Florence	-5.0*[a]	-9.3**	-9.1**	-11.2**	-7.6**	-6.7**	-6.9	-0.40	-7.5
Shafter	-1.3	+1.1	-6.9*	-3.2	-7.7*	-3.0	-0.6	-1.6	-2.9
	Zero-gap jaws, slow car speed								
Florence	-3.3	-6.8**	-5.7*	-1.8	-3.2	-7.3**	-6.5**	-2.8	-4.7
Shafter	-1.9	-7.0**	-5.9*	-6.6**	-5.9*	-6.0**	-4.2*	-1.6	-4.9
	1-mm-gap jaws, slow car speed								
Florence	-2.9	-3.5	-6.1*	-5.1*	-9.1**	-12.4**	-7.2**	+0.9	-5.9
Shafter	-4.9**	-12.1**	-10.3**	-9.5**	-12.0**	-9.5**	-11.3**	-12.7**	-10.3
	Mean length, Suter-Webb, inches[b]								
Florence, Unwea.	.92	.92	.91	1.09	.89	.85	.85	.92	
Florence, Wea.	.89	.92	.84	1.00	.80	.79	.82	.80	-.061
Shafter, Unwea.	1.00	.92	.93	1.14	.94	.88	.90	.92	
Shafter, Wea	.94	.92	.91	1.02	.92	.80	.87	.84	-.051

[a]* denotes a significant mean difference at .01 level and ** at .05 level.

[b]Each figure a mean of duplicate determinations, the average deviation of the individual values from this mean for all pairs being 0.009 inches.

Strength

Methods for determination of strength of raw cotton have been for some time and still are a subject of debate and discussion. The Pressley method has been extensively used by cotton breeders and others and was employed in this investigation in numerous comparative tests on weathered and unweathered fibers. The conclusions which may be derived from the tests conducted are somewhat limited by the fact that relatively slight alterations in the method give rise to quite distinct differences in the results obtained. This circumstance is illustrated by the data of Table 4, in which it is seen that a variation in the speed of the car (as brought about by a slight change in the balance of the instrument) shifted the station-average loss in breaking strength, as did also the use of jaws with a 1-mm gap in place of the usual "zero-gap" jaws. In general, however, the results in Table 4, also those in Table 5, showed a loss averaging rather less than 1 percent of the original strength lost per week of weathering. It is not known that the use of some other method for strength determination might not have resulted in either higher or lower losses.

In Table 1, strength values obtained by the use of the "Stelometer" of Dr. K. L. Hertel, with a 1/8-inch breaking span are shown. The results shown were provided by Dr. Hertel. Also in the same table are values for elongation as determined on the Stelometer. The tendency for weathered samples to exhibit decreased elongation at break may be noted.

Table 5. Fiber properties of cotton from bolls tagged on the day of opening and weathered in the field at Florence, S. C. in 1951. Variety Coker 100W.

Date of harvest	Days weathered	Rainfall, cumulative in inches	pH	Copper reduction values	Alkali-centrifuge values	Pressley index (1-mm gap jaws)	Mean length (Suter-Webb)	
Aug. 27	0	0	6.9	.74	202	4.75	1.03	1.06
31	4	0	6.6	.56	220	4.86	-	-
Sept. 3	7	0	6.8	.44	216	4.92	-	-
7	11	.4[a]	7.9	.36	209	4.49	1.00	1.00
10	14	.4	7.9	.35	204	4.46	-	-
14	18	.4	7.8	.40	205	4.46	-	-
17	21	1.61[b]	9.0	.17	216	4.48	-	-
20	24	2.01	9.4	.17	215	4.41	1.00	1.03
28	32	2.99	9.4	.12	233	4.48	-	-
Oct. 5	39	3.00	9.4	.16	235	4.47	-	-
12	46	3.61[c]	9.4	.14	232	4.60	1.00	1.01
19	53	3.61	9.6	.14	234	4.44	-	-
26	60	3.61	9.4	.12	233	4.32	-	-
Nov. 4	69	5.52[d]	9.7	.11	237	4.50	1.00	1.04

[a] Rainfall of .40" on 9/7.
[b] Rainfall of 1.20" and 0.01" on 9/15 and 9/16 resp.
[c] Rainfall of 0.61" on 10/10.
[d] Rainfall of .09", .38", and 1.43" on 10/1, 10/2, and 10/3.

Table 6. Mean length by the Suter-Webb technique and aqueous-extract pH of fiber of the variety Coker 100 exposed to weathering prior to harvest in 1951 and tested in January 1952 and at intervals thereafter.

Date of determination	Values obtained on samples harvested on:- 8/27/51	9/7/51	9/20/51	10/12/51	11/4/51
		Mean length in inches			
Jan., 1952	1.05	1.00	1.02	1.00	1.02
Apr., 1952	1.08	1.04	0.98	0.99	1.00
July, 1952	1.05	1.03	1.02	1.00	0.97
Oct., 1952	1.03	1.00	1.02	0.94	1.00
Oct., 1953	1.07	1.00	0.99	0.98	1.02
		Aqueous-extract pH			
Jan., 1952	6.9	7.9	9.4	9.4	9.7
Apr., 1952	6.4	7.0	7.5	7.7	8.2
July, 1952	6.7	7.2	7.9	7.8	8.0
Oct., 1952	6.5	6.8	7.2	7.3	7.5
Oct., 1953	6.5	7.1	7.4	7.6	7.8

Length

Numerous length determinations have been carried out on unweathered and weathered samples with the Suter-Webb sorter. Attention is directed first to the data of Table 4, in which it is seen that in spite of large differences in amount of rainfall, the Florence and Shafter samples averaged almost the same in length loss. These results suggest that sunlight may be quite as effective as humid-weather exposure in causing decreases in fiber length. Data in Table 5 showed a loss of only .03 inch during weathering for approximately 10 weeks at Florence, South Carolina in 1951. Similarly, cotton weathered 10 weeks prior to harvest at Florence in 1953 showed only .02 inch loss in length.

It has been the experience of Hall and Elting (5) that the Suter-Webb mean length of certain high-pH samples seems to decrease during storage of the fiber. To further investigate this interesting point, several samples of cotton weathered for different time periods at Florence in 1951 and exhibiting widely differing pH values were tested on the Suter-Webb sorter before and during a period of storage under room conditions. The results, Table 6, did not bring out the occurrence of any consistent loss in length of the high-pH samples during storage. These results are not considered to be necessarily contradictory to those of Hall and Elting, whose experiments may have differed in some unknown way from the experiment of Table 6, but it certainly seems true that not all high-pH samples lose length in storage.

Appearance of the Fiber under Ultra-Violet Light

The possibility of using the appearance of raw cotton under ultra-violet light as a quick diagnostic criterion to select out damaged fiber samples has been suggested by the recent results of Sheehan, Bailey, and Compton (15). These authors cite much older reports to the effect that aged cotton assumes a dull-ivory color under ultra-violet illumination as contrasted with a violet color for new cotton and point out that a very similar change can be caused by simply heating the fiber. Recently harvested fiber over-heated prior to ginning could perhaps be detected by this means, although the possibility is recognized by these authors that weathering and attendant microbial effects might introduce complicating factors (15). While no exhaustive experimentation on this subject can be reported here, a few definite and relevant facts are available.

Samples of Coker 100W cotton fiber naturally infected with micro-organisms during preharvest weathering at Florence, in 1953 were examined under ultra-violet light in November, 1953. The samples had been weathered for periods of 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10 weeks, and exhibited aqueous-extract pH values of 7.0, 7.2, 8.6, 8.7, 8.6, 8.8, 8.9, 8.7, 8.8, 8.6, and 8.7. As seen under the Mineralight in a darkened room, these samples showed no noticeable difference in appearance. It was decided to try to determine if some of the common fungi which might be found on cotton fiber at the time of ginning would cause a change in appearance of the fiber under ultra-violet if they were inoculated onto the fiber and allowed to grow there in a saturated atmosphere, i.e. under conditions in which the aqueous-extract pH, reducing-substance content, alkali-centrifuge values, alkali-swollen fiber width, Congo Red values, and absorption of Chlorantine Fast Green are known to undergo changes as a result of the growth (10). The fungi used were Alternaria sp. 140, Aspergillus niger TC-215-4247, Aspergillus terreus 45, Cladosporium sp. 113, Diplodia sp. 136, Fusarium moniliforme 102, Penicillium ochro-chloron 1336.2, and Stemphylium sp. 1203.1. The fiber was examined after incubation periods of 4, 7, 11, and 14 days. In spite of the fact that the expected large changes in aqueous-extract pH occurred with these samples, their appearance under the Mineralight showed only very doubtful and insignificant alteration. It has been established therefore that certain common fungi may grow on cotton fiber and produce major changes in aqueous-extract pH without causing any alteration in appearance of the fiber as seen under the ultra-violet Mineralight. The fluorescence mentioned on an earlier page for microbial tight-lock samples from Blythe, California is much brighter and more localized in spots than has been seen in this laboratory with heated or aged samples.

ACKNOWLEDGMENT

The authors wish to acknowledge with thanks the helpful cooperation of numerous individuals who have collected samples in the field for the work here described. Particular gratitude is due in this connection to Mr. D. C. Harrell at Florence, South Carolina and Mr. J. B. Dick at Stoneville, Mississippi.

APPENDIX

"Copper-2" method for determination of reducing-substance content of raw cotton

Weigh a 0.50-gm. cotton sample into a test tube (25 x 200mm). Add 10 cc of a copper reagent, of composition noted below, and 10 cc of .05% Aerosol-water solution. Tamp and stir with a glass rod with flattened tip and spread out the fiber in the solution. Cover test tube with a "tear-drop" or other suitable air condenser and place in a constant-temperature bath at 85° C. Tamp and stir again after 15 minutes. Solution level in the test tube should be about 1 inch below the level of the liquid in the bath. After a total period of 45 minutes at 85° C, remove tube and cool to room temperature by immersion in water. Swab down walls of test tube with cotton sample by means of glass rod. Then tamp sample. Pipette out exactly 10 cc of the solution into a 125-cc Erlenmeyer flask containing 2 g. of KI; allow to dissolve. Add 2 cc of 4 N H_2SO_4. Shake vigorously until release of CO_2 subsides. Then titrate with .005 N sodium thiosulphate until solution becomes a pale yellow. Let stand about a minute. Add 1 to 2 cc starch indicator solution and titrate until solution remains colorless for 5 minutes. Run a blank, without sample, as above.

The copper reagent has the following composition:- Na_2CO_3, 25.0 gm.; Rochelle salts, 25.0 gm.; $CuSO_4$-5 H_2O, 8.0 gm.; $NaHCO_3$, 20.0 gm.; and KI, 1.0 gm. To prepare the reagent, add the Na_2CO_3 to about 600 cc of distilled water in a liter beaker. Stir until dissolved. Then add other reagents in the order listed, as each dissolves adding the next. Boil very gently for 2 minutes (Caution: bumping). Transfer to a liter volumetric flask, rinse beaker four times with 100-cc portions of distilled water. Let solution stand over night. Adjust to liter mark and filter through a fritted glass filter. Store in a pyrex bottle.

The copper reduction value is defined as the number of grams of copper reduced per 100 grams of fiber. Under the conditions described:-

Copper reduction value = .1272(cc thio for blank - cc thio for sample).

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U. S. DEPARTMENT OF AGRICULTURE, AGRICULTURAL RESEARCH SERVICE

NEW OR UNUSUAL RECORDS AND OTHER BRIEF NOTES ON PLANT DISEASES

PUCCINIA OAHUENSIS ON DIGITARIA ISCHAEMUM AND D. SANGUINALIS IN LOUISIANA

By W. H. Stroube

The rust caused by Puccinia oahuensis Ell. & Ev. was first described in 1895[1] on the leaves of an unknown grass from the Sandwich Islands. It has since been reported on a number of species of Digitaria in various parts of the world.

In September 1953 a rust was found on the leaves of smooth crabgrass, D. ischaemum (Schreb) Muhl., in lawns at Baton Rouge, Louisiana. Subsequent collections showed it to be present also on hairy crabgrass, D. sanguinalis (L.) Scop. Urediospores were abundant and a few teliospores were found mixed with them, apparently from the same pustules. Spore measurements and characteristics corresponded very closely to those given in the original description, and by Cummins[2], of Puccinia oahuensis. Hiratsuka and Yoshimaga[3] report the collection of this rust on Syntherisma ischaemum = D. ischaemum, in the Orient.

This is apparently the first record of this fungus in Louisiana. A check of the available literature does not reveal a previous report of the occurrence of Puccinia oahuensis on D. ischaemum in the United States.

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[1]Ellis, J. B. and B. M. Everhart. 1895. New species of fungi. Bull. Torrey Gdn. 22:434-440.

[2]Cummins, G. B. 1943. Description of tropical rusts IV. Bull. Torrey Bot. Gdn. 70:517-530.

[3]According to personal communication with Mr. John A. Stevenson (letter dated October 26, 1953), the following two references pertain to the subject, but were not seen by the writer:

Hiratsuka, N. and T. Yoshimaga. 1935. Uredinales of Skikoku. Mem. Tottari Agric. College 3:249-377. p. 12.

_____, and _____. 1935. Uredinales collected in Formosa III. Bot. Mag. (Tokoyo) 49:19-26. p. 20.

BROWN ROT OF CITRUS FRUIT ON THE TREE IN FLORIDA

By Erdman West,[1] Mortimer Cohen,[2] and L. C. Knorr[2]

Brown rot of citrus fruit on the tree (caused by Phytophthora spp.) hitherto unknown in Florida, was found in three different citrus-growing areas in this State in October, 1953. Infection on the tree has been known in California for many years.

The first infected fruits were collected in Indian River County and sent to the Agricultural Experiment Station in Gainesville by the late Marcel Boudet, County Agricultural Agent at Vero Beach. The identification was made immediately and the Florida State Plant Board was alerted.

No comprehensive or exhaustive survey has been conducted for the distribution of the disease, but numerous groves from Wabasso to Ft. Pierce along the East Coast, one grove on Merritt Island, and two groves in Hendry County in south-central Florida were found to contain trees with infected fruit. As much as 90 percent of the crop was lost from individual trees and an aggregate loss of 30 percent was estimated for some groves.

The disease has been seen on a number of varieties of early and midseason oranges including Pineapple, Hamlin, Navel, and Temple. An undetermined variety of grapefruit has also been found to be affected. It has not been observed on the late-season Valencia variety.

Infected fruits of the above-mentioned varieties developed profuse growth of a Phytophthora when incubated for several days in moist chambers at room temperatures. No growth appeared in six days when incubated at 50° F. Isolations from infected fruits yielded the same sort of Phytophthora. In culture the growth at room temperatures is cottony with considerable aerial mycelium on potato dextrose agar. Sporangia are produced in abundance on infected fruits. Sporangia from fruits or cultures are strongly papillate and variable in dimensions. Judging by the type of growth on agar and the temperatures at which growth and infection have occurred, the organism is probably Phytophthora parasitica Dastur. This fungus has been known for years in Florida as the cause of foot rot of citrus trees and the decay of citrus fruits on the ground. Phytophthora citrophthora (R. E. Sm. & E. H. Sm.) Leonion has also been known in

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[2]Pathologist-State Plant Board of Florida

Florida to cause a decay of citrus fruits on the ground, but only at low temperatures. This organism, which in addition to having a lower temperature requirement also develops a characteristic fan-type growth on agar, seems to be ruled out in this outbreak. In the light of this information, P. parasitica is considered to be the cause of brown rot in Florida.

Unusually heavy and consistent rains in September and October are believed to have contributed to this outbreak. In the field, however, the most severe cases have not always been in the lowest or wettest portions of the grove.

Observers in the Ft. Pierce area report that the general symptoms of this disease have been seen there for the past three years. The trouble was observed in one grove in 1951, and in 1952 was seen in the same grove and in another 75 miles distant. This year brown rot is known to exist in at least 15 groves.

GAINESVILLE, FLORIDA

FERTILE ALBINO MUTANTS OF THE OAK WILT FUNGUS[1]

By H. L. Barnett, R. P. True and F. L. Brown

The appearance of white patches of mycelium in aged cultures of the oak wilt fungus (Endoconidiophora fagacearum Bretz) is well known to those who have cultured the fungus over a long period of time.[2, 3] Some of these light colored mutants have been shown to be unisexual males,[4] and none have been reported as producing perithecia. Furthermore, no one has reported finding a white mutant in nature.

In the spring of 1953, a white mutant was isolated from the normally dark West Virginia culture No. 645, which was cultured from an oak wilt tree in 1951. This albino mutant (No. 645M) proved to be bisexual and apparently like culture 645 in every way except for the complete lack of pigmentation. The F_1 single ascospore cultures from a cross between 645M and a compatible dark culture segregated into one-half dark cultures and one-half albinos. Culture No. 645M and two of the F_1 albino cultures have been proved to be pathogenic by inoculation tests. Results of inoculation studies will be reported elsewhere.

In September 1953 samples from a tree showing symptoms of oak wilt in Logan County, West Virginia, were cultured and yielded a pure white fungus having all of the diagnostic characteristics of the oak wilt fungus except for color of mycelium. The tree was resampled in November and again only the white oak-wilt fungus was isolated (culture No. 2126). Cultures of 2126 were used both as male and as female in crosses with dark cultures of A and B compatibility types; all were found to be bisexual and of B type.

The albino culture 2126 agrees in all respects of color, compatibility type, sexuality and approximate growth rate with albino No. 645M. In all cases when albino cultures were used as female the resulting perithecia were pure white.

The isolation of an albino oak wilt fungus from a naturally infected tree strengthens the idea that the fungus is quite variable in nature as well as in pure culture. The origin of the inoculum for this particular oak tree is open to speculation. However, one must conclude that this mutant is capable of existing in nature and that its virulence may be as great or greater than the fungus from which it arose.

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[1]Published with the approval of the Director of the West Virginia Agricultural Experiment Station as Scientific Paper No. 484.

[2]Henry, B. W. 1944. Chalara quercina n. sp., the cause of oak wilt. Phytopathology 34:631-635.

[3]Campbell, Robert. Personal correspondence.

[4]Barnett, H. L. 1953. A unisexual male culture of Chalara quercina. Mycologia 45:450-457.

FALSE BROOMRAPE OF TOBACCO IN FLORIDA

By George F. Weber

False broomrape as reported by Valleau (PDR 37: 538-539) appeared in Alachua County near Gainesville in 1951 and again in 1952, being brought to our attention by Mr. Fred Clark of the Agronomy Department of the Florida Agricultural Experiment Station. At the time the trouble was observed no causal agent was applied. The disease at first glance had all the appearances of the broomrape parasite. Upon more detailed examination there were no indications of that plant. The descriptive details closely follow those given concerning the trouble in Kentucky. Most of the abnormal growth occurred under the soil surface except in a few instances where some of the clumps of whitish, curled, submerged leaf-like growth appeared

above ground and was normal green in color and possessed the general texture of healthy tobacco foliage. These growths appeared on pencil size seedlings soon after setting and on two-thirds grown plants. Many possible causes have been offered but none seem to fill the bill. No research has been done.

GAINESVILLE, FLORIDA

FIRST DEPARTMENT OF PLANT PATHOLOGY IN A UNITED STATES UNIVERSITY

By Roy Bardin

The Department of Plant Pathology at the University of California was founded several years before that of Cornell University, cited as the first in the United States (PDR 37:575).

Through Dr. M. W. Gardner and Dr. Wm. C. Snyder I was able to discover that in the announcements of the College of Agriculture for 1903-4, 1904-5, 1905-6, a course in plant pathology taught by the late Prof. Ralph E. Smith is listed. Thus Prof. Smith not only established the first permanent department of plant pathology in a United States university but organized a course of study in connection with the office he held as well.

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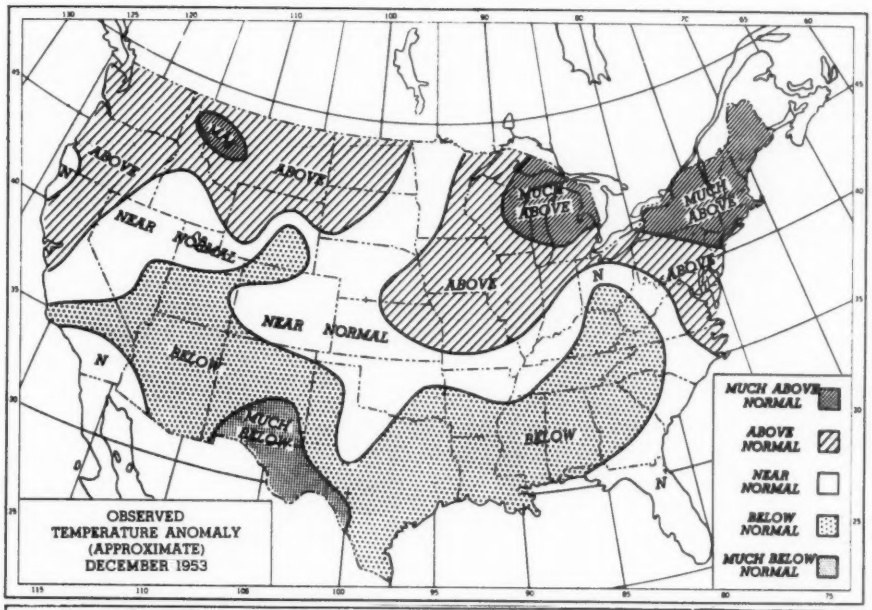
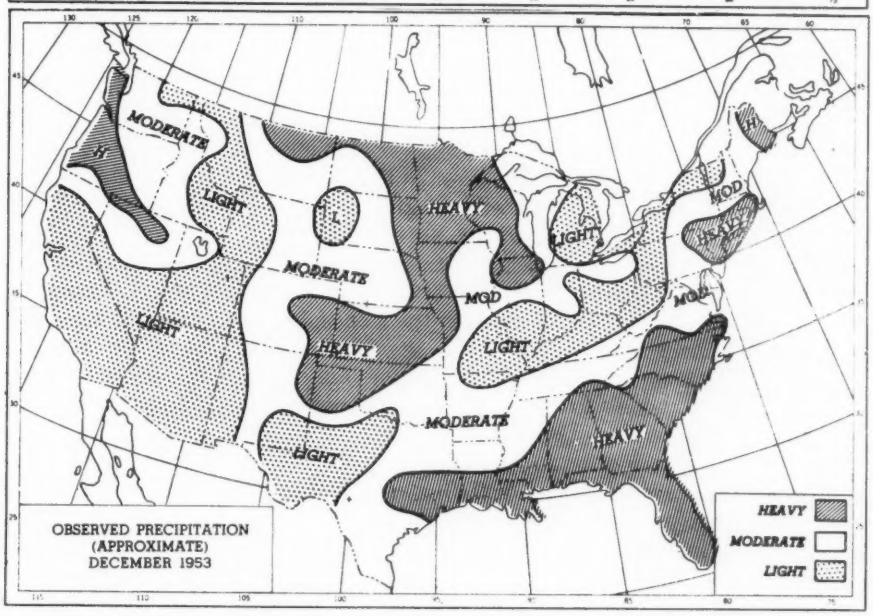
A CORRECTION

In the article, "Recent epidemics of downy mildew of rose", in PLANT DISEASE REPORTER 37: 335. June 15, 1953, the following correction should be noted in line 11: "The 1952 Indiana outbreak: the epidemic in August 1952--" should read "The 1951 Indiana outbreak: the epidemic in August 1951--".





The terms used in the accompanying maps, which define the ranges of temperature and precipitation, are numerical class limits. These are based on a statistical analysis of past records through which is determined the normal frequency of occurrence of temperatures and precipitation at various times of the year for different locations. For temperature the classes above, below, and near normal are so defined that they each normally occur one-fourth of the time; much above and much below normal, one-eighth of the time. Precipitation is depicted in terms of light, moderate, and heavy, each class normally occurring one-third of the time and thereby having equal probability of occurrence. These maps graphically represent only the general trends and give the country's weather picture at a glance. For quantitative studies, where monthly mean temperatures and actual precipitation records are needed for a given time and place, other publications of the Weather Bureau should be consulted. P. R. M.